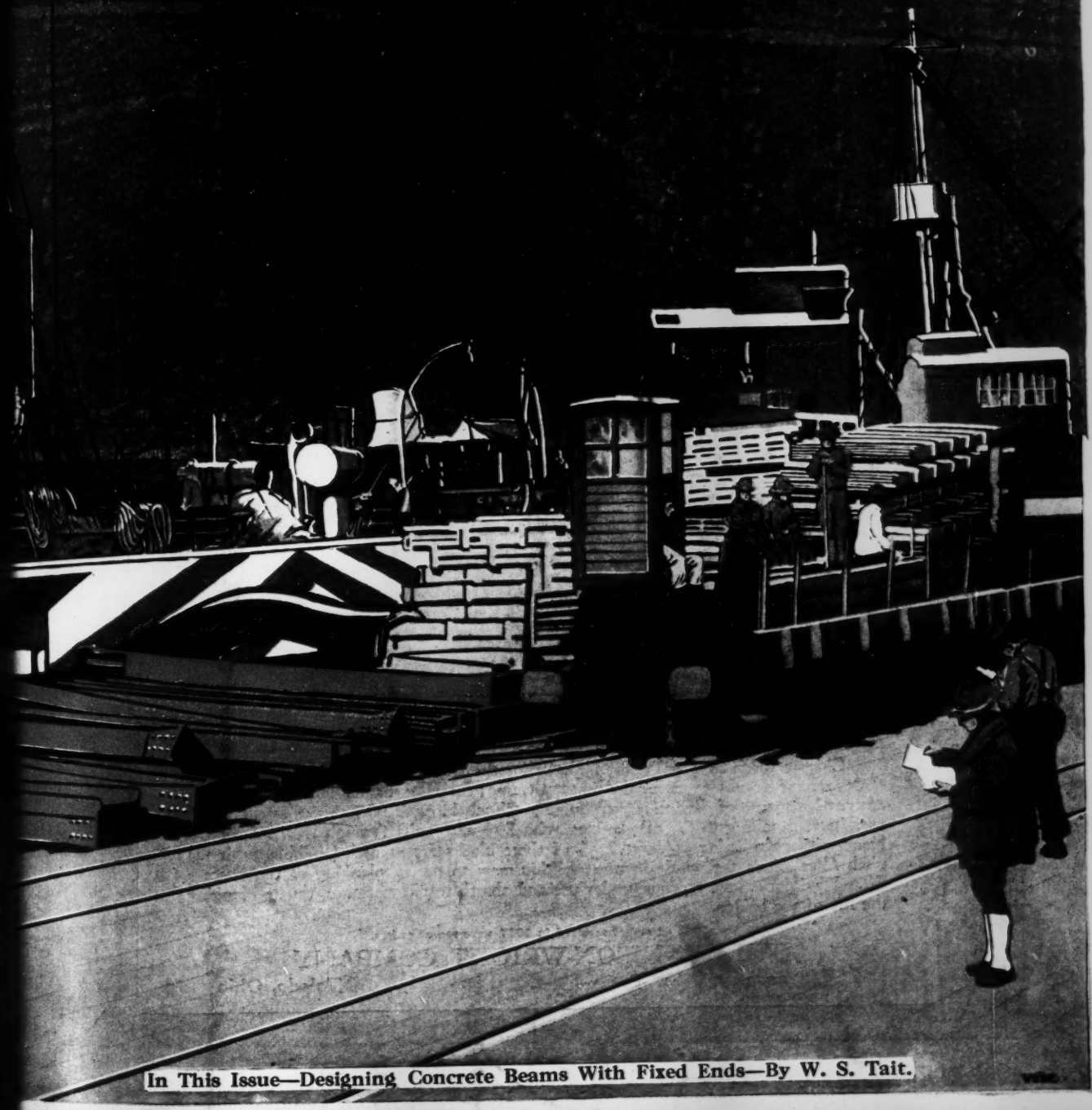
GENERAL LIBRARY
AUG 26 1912

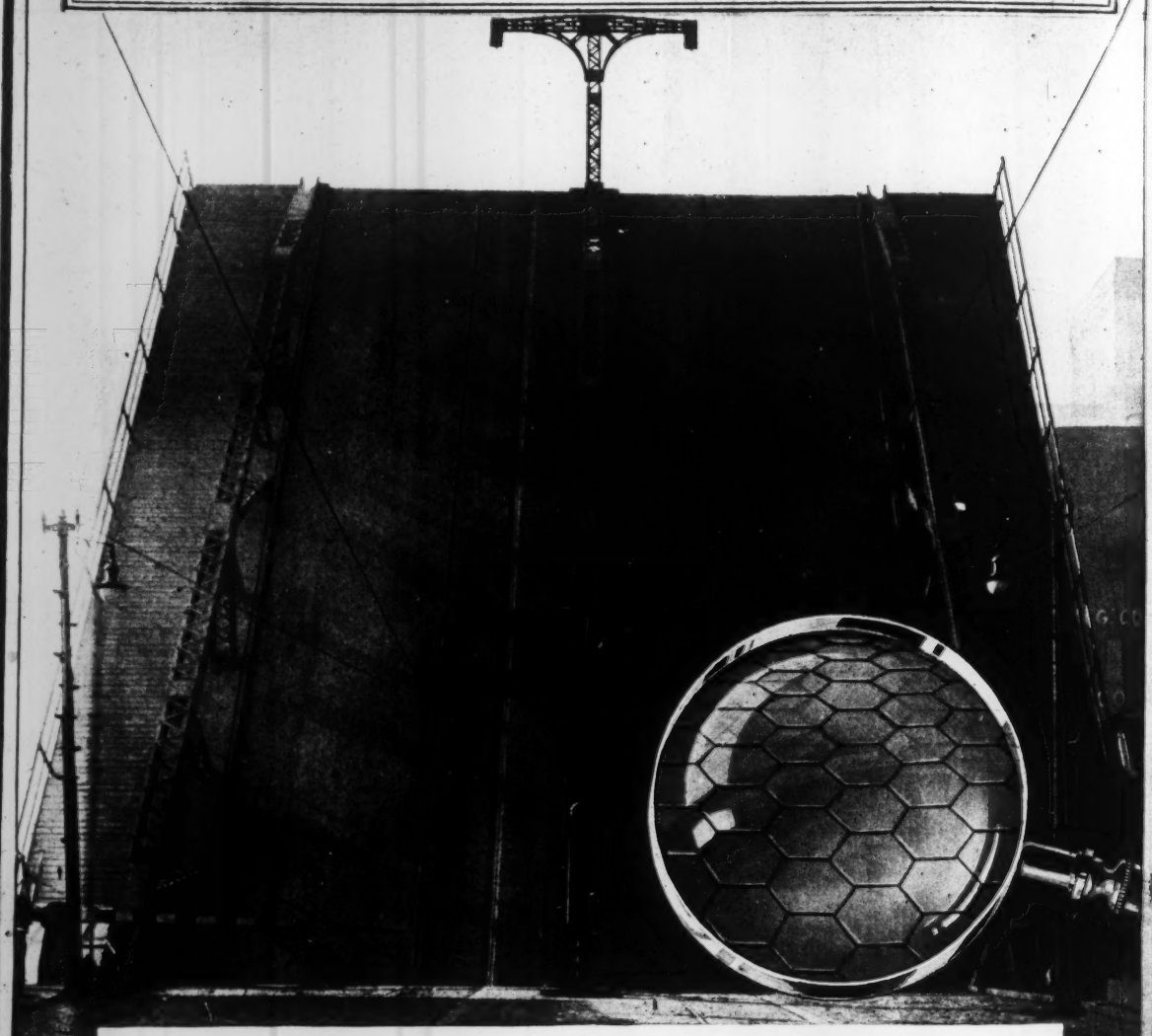
Engineering News-Record



In This Issue—Designing Concrete Beams With Fixed Ends—By W. S. Tait.

Kreolite Hex

WOOD BLOCK FLOORS *Best for Bridges*



Kreolite Hex Wood Blocks on Randolph St. Bridge

Chicago specified Kreolite Hex Blocks for the Randolph Street Bridge because of their extreme durability under the heaviest traffic; the Hex shape also provides for the destructive thrust of expansion and bulging. Each block is 90% heart wood, which permits face nailing to the subplanking with 20d wire nails through the heart of the block without splitting. About 25% of these blocks are so nailed. This, with the pitch filler, binds the whole in a monolithic mass to the subplanking of the Bascule lift. Hex blocks knit together under use and absorb traffic vibration, thus prolonging the life of the bridge.

50% of orders received in 1917 were repeat orders.

THE JENNISON-WRIGHT COMPANY

2479 Broadway Toledo, Ohio

Volume 81 August 22, 1918 *Number* 8

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR.

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

Roads in Base Section of American Forces Require Widening and Resurfacing 348
BY R. K. TOMLIN, JR.
HEAVY TRAFFIC by Motor Trucks and Artillery on Practice Marches Necessitates Continuous Maintenance.
Engineering News-Record, Aug. 22, 1918. 9 cols. Ill.

Appropriates Supposed Power of Highways Council 352
Engineering News-Record, Aug. 22, 1918. 2 col. Ill.

Two-Year Engineering Course Urged by British Engineer 353
Engineering News-Record, Aug. 22, 1918. 2 col.

War-Time Changes in Education at Three Institutions 354
Engineering News-Record, Aug. 22, 1918. 1½ cols.

Build Walls and Roof Before Second Floor 354
Engineering News-Record, Aug 22, 1918. 1 col. Ill.

Framing Plans Simplify Fieldwork on Cincinnati High School 355
SINGLE SHEET Framing Plan Gives All Data Required by Form Workers and Steel Men. Condensing Information From Several Sheets of Architect's Drawings.
Engineering News-Record, Aug. 22, 1918. 5 cols. Ill.

Wisconsin Board Rejects Reproduction Cost Less Depreciation 357
Engineering News-Record. Aug. 22, 1918. 1 col.

More Data on Filter Sand Growth at Grand Rapids 358
Engineering News-Record, Aug. 22, 1918. 1½ col. Ill.

Long-Span Concrete Beams Should Have Fixed Ends 359
BY W. S. TAIT.
METHODS GIVEN by which computation of rigid frame design may be readily made.
Engineering News-Record, Aug. 22, 1918. 4½ cols. Ill.

Land Reclamation Would Provide Work and Homes for Hosts of Veterans 361
BY ARTHUR P. DAVIS.
IRRIGATION AND DRAINAGE of 20,000,000 acres would care for million families in agricultural and allied pursuits—Water-power development incidental to irrigation would save fuel and aid transportation.
Engineering News-Record, Aug. 22, 1918. 6½ cols.

Rock Cribs Blanket River Bank in California 364
Engineering News-Record, Aug. 22, 1918. 2½ cols. Ill.

Will Complete New Railway Route to Pacific Coast 365
Engineering News-Record, Aug. 22, 1918. 1¾ cols. Ill.

What and Where to Buy 136
Searchlight Section 52-83

Unit Costs for Setting Water Meters 366
BY ALLEN F. BREWER.
Engineering News-Record, Aug. 22, 1918. ¾ col.

Grouting Wells in Rock Formation Effective and Simple 367
BY W. G. KIRCHOFFER.
Engineering News-Record Aug. 22, 1918. 3 cols. Ill.

Making a Stream Build Its Own Check Dams 368
BY ALBERT MARPLE.
Engineering News-Record, Aug. 22, 1918. 2 col. Ill.

Plank Trusses Carry Streets Over Depressed Tracks 369
Engineering News-Record, Aug. 22, 1918. 2 cols. Ill.

Lake Beach Sand Has High Load-Sustaining Value 370
BY W. S. THOMAS.
Engineering News-Record, Aug. 22, 1918. 2 cols. Ill.

Hints for the Contractor

Prompt Reward Incites Effort 375
Concrete Walls for Wood-Frame Mine Mill Placed With Cement Gun 375
Shows Size and Span of Sheeting at a Glance 376
BY S. M. COTTON.
Build Concrete Pier in Ice Twenty-five Feet Thick 376
Cast Pickup Bars for Handling in Concrete Piles on Java Contract 377
Triple Scarf Used in Drydock Timbering 377

Other Articles of Interest to Contractors:

Roads in Base Section of American Forces Require Widening and Resurfacing 348
Build Walls and Roof Before Second Floor 354
Framing Plans Simplify Fieldwork on Cincinnati High School 355
Rock Cribs Blanket River Bank in California 364

Editorials 343
Society Service 371
Letters to the Editor 372
News of the Week 378
News of Engineering Industries 382
Contracting News 93

Index to Advertisers 144

McGRAW-HILL COMPANY. INC., 10th Avenue at 36th Street, NEW YORK

JAMES H. McGRAW, President
ARTHUR J. BALDWIN, Vice President
E. J. MEHREN, Vice President
EDWARD CALDWELL, Treasurer
JAMES H. McGRAW, JR., Secretary

WASHINGTON, D. C., 1410 H Street, N. W.
CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
SALT LAKE CITY, 1101 Newhouse Building
SAN FRANCISCO, Rialto Building
LONDON, E. C., 6 Bouverie St.
PARIS, 3, rue Theodore-de-Banville, Paris, XVIIe
Robert K. Tomlin, Jr.
Representative and War Correspondent

Cable Address: "Machinist, N. Y."

Publishers also of
Electrical World
American Machinist
Power
Engineering and Mining Journal
Electrical Merchandising
Coal Age
Chemical and Metallurgical Engineering
Electric Railway Journal

United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines, $5 per year; Canada, $7; elsewhere, $9. Single copy, 20c.

No back volumes for more than one year and no back copies for more than three months.

Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at least ten days before the change takes place.

Copyright, 1918, McGraw-Hill Company, Inc. Published Weekly. Entered as second-class matter Apr 11, 1917, at the Post Office at New York, under the act of Mar. 3, 1879.

Member Audit Bureau of Circulations. Member Associated Business Papers, Inc.

CIRCULATION OF THIS ISSUE, 33,500 COPIES

LIGHT POWER BENDER IN ONE OF OUR SHOPS

To Concrete Contractors:

THE conservation and proper distribution of labor is necessary to help win the war. We can save 80% of the labor on your bending by doing the work in our shops on power machines instead of doing the work in the field, and it will cost you less money, as well as save time.

By using bar-tys, ty-chairs and other concrete specialties manufactured by us, you will also conserve labor, and at the same time save money. Let us tell you more about our time- and labor-saving devices.

CONCRETE STEEL COMPANY

42 Broadway, New York

Boston Philadelphia Birmingham Chicago Cleveland Detroit Syracuse

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor
CHARLES WHITING BAKER, Consulting Editor

Volume 81 — NEW YORK, THURSDAY, AUGUST 22, 1918 — Number 8

Land Reclamation and Reconstruction Problems

INADEQUATE though it be, the $100,000 recently appropriated by Congress to investigate the reclamation of over-wet and of cut-over timber lands insures a beginning of a study fraught with great possibilities. Elsewhere in this issue A. P. Davis, director and chief engineer of the U. S. Reclamation Service, under whom the investigation will be made, reviews the vast potentialities of land reclamation as an aid to solving our post-war reconstruction problems, when three million soldiers and a like number of war-industry workers will be returned to civil life. It is fortunate indeed that the investigation has been entrusted to the Reclamation Service, with its large experience in such work, and with its reputation for ability and integrity.

Broader Reconstruction Studies Are Needed

CONGRESS must be convinced that the country is alive to the reconstruction problem. Next to winning the war, which we are helping to do, comes taking care of the veterans from trench, shipyard, factory and military offices. The $100,000 appropriation for land and reclamation studies mentioned in the foregoing note is but a twentieth part of the sum urged by Secretary Lane for reconstruction studies, as was noted in these columns June 10, p. 1161. The immense total of swamp and of cut-over timber lands and their wide distribution over the country, shown by the article by Mr. Davis, afford a partial illustration of reconstruction possibilities. Mr. Davis also touches incidentally on water-power opportunities, adequate investigations of which alone would cost many times $100,000. These are only two of many possibilities. There are others, not only of a national character, but also in the state, county and municipal fields. All of them need study, and the many and various studies must be correlated. The Federal Government must lead, and it cannot without more adequate congressional authorization and appropriation.

Where Are Reconstruction Engineers to Come From?

ENGINEERING studies cannot be made without engineers. A rapidly increasing percentage of the best engineers of the country are in the army or the navy, in the shipyards or other war industries. More are going every day. Where, then, are the engineers for reconstruction studies to come from? Already the state and municipal services and private industries have been stripped bare of their best men by the military and civilian departments of the Federal Government. Private industries, which will of course play a great part in reconstruction, will require engineers to work out plans, just as will the cities, the states and the country, for reconstruction work in many and various fields. The problem of supplying engineers is being taken up vigorously by some of our engineering schools, as is discussed editorially and discriptively further on in this issue. Washington authorities, both legislative and administrative, should lose no time in providing for men to take up the study of reconstruction—and also for counteracting the possible serious effects of drawing ruthlessly upon the engineering forces of our states, counties and cities.

Propose "Wet" Roads for the Farmers

WET roads are a paradoxical proposal when, generally speaking, the farmers are crying for bond issues to get them out of the mud. Possibly it was the humor of the idea which appealed to the Michigan State Hotel Association when it adopted the slogan "Good Roads, Cider, Wine, Beer," in an effort to become an invisible tail to a popular kite, and put through an amendment to the State Constitution permitting the sale of the lighter alcoholic beverages. Although the swag is to be split three ways, the hotel men mention only the portion which would go to highways, and have underscored the word in their advertisements as if they were unselfishly devoting themselves to improved rural transportation, without a thought of the liquor traffic. Or perhaps they mean to convey the idea—and a very proper one, too—that the farmers will need good roads to go home on after a few rounds at the bar. Certainly this ill-advised and untimely expedient of dragging the issue in by the ears to the confusion of a most important subject will bring down on the astute Solons who devised it the contempt they so richly deserve.

How Cities Can Help Win the War and Save Money

MANY cities which are anxious enough to help win the war are slow in seeing obvious ways in which they can do so—and put money in their treasuries at the same time. One way is to convert their garbage into grease, glycerine and fertilizer by reduction, or else into pork by feeding it to hogs. Bayonne, N. J., has just seen the light, through suggestion from Washington, and has postponed its plans for a garbage incinerator. The food administration is doing good educational work in this line. If it has not already done so it might well seek the coöperation of the Capital Issues

Committee with a view to preventing the approval of bond issues for garbage incinerators until expert investigation has shown that utilization by one or the other means already indicated is not feasible.

A Notable Commission Completes Its Work

JUNE 30 last an unusual commission went out of existence. After 24 years of honorable service, the Boston Transit Commission ceased to be, having completed all the subways Boston felt the need of for the present. Prof. George F. Swain served on this commission throughout its entire twenty-four year life. Horace G. Allen served all but two years, having replaced a member who resigned in 1896. The remaining three members replaced three of the original commission who had died. Throughout its entire existence the commission has been practically free from political influence, and has never been charged with waste, extravagance or inefficiency. In the construction of the original Tremont St. subway, and the later Washington St., East Boston, Boylston St. and Cambridge subways, many very intricate technical problems were solved. The example set by the commission to other similar bodies is of the best. Equally good is the example to legislatures and Government executives as to what can be accomplished when such a body is kept clear of the spoils system.

Denver Water-Works Pass to Municipal Ownership

COMPETING water companies have been so few and so small as to have almost escaped notice. The heavy vote (4448 majority) for the municipal purchase of the property of the Denver Union Water Co. on Aug. 6 brings to mind the most notable example—and failure—of competition between water companies in this country. It also marks the end of a long and bitter conflict between the City of Denver and the company, besides diminishing by one the few larger cities dependent on private companies for their water supply. It was in the early nineties that a rival water company tore up the streets of Denver. A water rate war followed during which rates were cut until for a time one company supplied water at 75% discount and the other gave it away. Soon the inevitable consolidation followed. For the ensuing quarter century there has been a fight on in Denver over water rates, franchise extension or the establishment of municipal ownership. No wonder the majority in favor of purchase was high.

Yankee Business Methods Again

ACCORDING to men who have recently been in South America, there has been little improvement in the business methods of American firms in dealing with customers in that important part of the globe. Were it not that all European trade is cut off, practices such as those reported would bar us from South American markets were our prices the lowest and our goods the best in the world. Imagine yourself a South American contractor who had ordered 22-ft. reinforcing bars for a concrete building already designed and who had received a broken shipment averaging less than 15 ft. in length. Imagine further that on reporting the error, which appeared to you a deliberate failure to fill the order, the North American firm replied with a figurative shrug of the shoulders that it was "merely a mistake." Would you be inclined to pursue your career as a purchaser in the North American steel market to discover what further "mistakes" United States manufacturers might feel privileged to perpetrate? It is a well known fact that one of the largest American manufacturers of construction material not long ago found it advisable to cancel a contract which meant a small loss to it at the sacrifice of the good-will of one of the most powerful South American governments. Another firm not long ago furnished forms that varied from the drawings so greatly as to be useless, and after sending a man to investigate calmly wrote the contractor that there was very little the matter with them. With such methods the American manufacturer cannot hope to last long in the competition for world trade that will follow the war.

Garbage Contract Awarded Without Engineering Advice

RECENT contracts for garbage disposal in a group of three Western cities are on the basis of the contractor getting pay to remove garbage which he uses for feeding hogs, thus making pork for his own benefit, as noted last week. In other cities contractors have been willing to pay for the garbage—after collection at municipal expense. Whatever may be the merit of the particular contracts mentioned, the fact is that the negotiations in at least one of the cities were made directly between the city council and the contracting company, no engineer or other expert being consulted in the interests of the city or the public. As an indication of public opinion on the subject, *Engineering News-Record* is informed that the award of this contract resulted in ousting the entire council at an election immediately following this action. The award was confirmed by the new council, but at a lower figure.

Is Chaos to Return in Highway Control?

GOVERNMENT bulletins had given the impression that all Government agencies dealing with highway problems had been combined when the U. S. Highways Council was organized. The public had a right to infer that from then on a definite highway policy would be followed. That this has not resulted is evident from the report of correspondence (page 352) between the commissioners of Huron County, Ohio, and the District Capital Issues Committee at Cleveland.

The Highways Council adopted the policy of considering only such road work as had been investigated, and submitted to it and recommended for construction by state highway departments, saying that when thus recommended it would give the matter careful consideration and approve or disapprove. This decision appears to have been nullified by the action of the district committee mentioned in refusing permission to issue bonds for work approved by the council, and those who had fondly hoped that whatever the decisions might be, the committee would at least follow a uniform rule laid down by qualified officials, have had a rude awakening.

Instead of this an assistant secretary of a district

committee on capital issues has, in one case, inspected a road, decided adversely upon its military value, exacted a pledge from the county commissioner not to build that road or any other road until such work has been approved by the district committee, and has used as a veiled threat to accomplish his purpose the power of the committee to disapprove the sale of pending bond issues. Furthermore, this coercion has not stopped at interference with new work, but has extended to work for which funds have already been provided, and for which the contracts have been let.

In view of Government assurances, this must be strongly deprecated. Only expert military and highway engineers such as advise the Highways Council are competent to estimate the war value of a highway, and when such functions are delegated to unqualified persons, those responsible lay themselves open to justifiable criticism. Such conflict of authority, if allowed to continue, will throw the entire highway problem back into the chaotic condition which existed before the formation of the Highways Council.

Railway Electrification an Engineering Question

DIRECTOR GENERAL McADOO, in a widely published interview given out on his return from a two-months' tour in the West, declared that if the Government is to continue for any long period to operate the steam railways of the country he would be in favor of wholesale electrification.

In this interview Mr. McAdoo unconsciously revealed one of the inherent dangers of Governmental railway control. The question whether the railways of the country or whether a given system of railways should or should not be converted from steam traction to electricity is not one that should be decided by impressions gathered in a hasty tour by either a railway magnate or a Government magnate. It is a question which should be investigated by competent engineers, qualified to take all the elements of the problem into consideration and accord to each its proper weight. With the railways under private ownership, their managers must find out whether a proposed change or extension will pay or not before they can undertake it. On Government-owned railways no such automatic safeguard exists. Of course the Railroad Administration's budget committee gave careful consideration to various electrification projects earlier this year, and rejected them for this year's budget. But Mr. McAdoo's unqualified declaration in favor of electrification is a reminder that it is at any time possible for unwise projects to be undertaken, for political motives or to benefit private interests, for which the taxpayers eventually have to bear the burden. It is of course true that under private operation of railways wasteful and unwise enterprises are also frequently undertaken, but in that case those who suffer are only those who make the mistake of investing their money foolishly, and the burden does not fall on helpless taxpayers.

There is another point of view with regard to the effect of Government ownership on electrification of railway terminal lines which has been agitated for several years in a number of cities, notably in Chicago. The controlling idea in the agitation there was that the city would reap benefits from electrification and the burden of paying for them would fall on the private owners of the railways. Under Government railway ownership it should be easier to make clear to the public that whatever burdens are laid upon the railways must eventually be paid by the general public.

Mr. McAdoo could profitably add to the information gained in his Western travels a study of the monumental report of the commission headed by Dr. W. F. M. Goss, which presented in 1915 the results of several years' work in studying the feasibility of electrifying the railway terminals of Chicago. That commission found the cost of electrifying the railway terminals in Chicago alone to be in round numbers $275,000,000 on the basis of pre-war prices. Under present market conditions for labor and material the necessary investment would be between two and three times as much. It seems almost needless to add that there is no spare reservoir of either labor, material or capital for the undertaking of any such huge enterprise at the present time.

This is not written to oppose electrification as a policy, but to point out that the electrification of any particular road or system is not a question which can safely be decided except on the advice of expert engineers. Without doubt it is also a question which should be restudied in the light of present-day conditions. On the Pacific Coast, for example, the railways which have been for many years using cheap oil for locomotive fuel find that the days of cheap oil are over; and in northern California there is probably enough water-power possible of development to care for the railways' needs, as well as to furnish power and light for manufacturing and other purposes. Even in the arid Southwest there are possibilities in the development of water power on an enormous scale in the Grand Canyon of the Colorado which are doubtless deserving of study.

Secretary McAdoo's emphasis on the importance of water-power development as a means of conserving coal is most gratifying, and may not be without effect in spurring Congress to take action on the long-pending water-power bill. There is no doubt at all that great public works of this sort, as has again and again been emphasized in these columns, need to be studied and made ready for development against the days when there will again be a surplus of labor and of capital seeking employment. All these public works, however, whether they be railway improvement or extension, water-power development, or land reclamation by irrigation (on which Mr. McAdoo also comments most favorably) need first the expert study of engineers so that the labor and capital may be expended to the best advantage.

An Opportunity for Chicago's Engineering Societies

TWO matters of vital engineering importance, zoning and the return load question, are now before the Chicago Association of Commerce without an engineer being on either committee. This despite the fact that two engineering societies of Chicago are members of the association and the association itself has a subdivision of engineers. The association officials will surely welcome any assistance engineers can and will give, and it is a sad commentary on the society activity

of engineers that they have not been sufficiently in the public eye to make the business men turn to them immediately and instinctively as soon as the problems came up.

Membership in the association carries both responsibility and opportunity—responsibility to bear a share of the burden of civic betterment problems, and the opportunity to work shoulder to shoulder with the staunchest business men of the city. Here the great labor problem is being threshed out from every possible angle. No better counsellor from the standpoint of information is available than the engineer standing midway between capital and labor. But the engineer is most conspicuous by his absence.

The way is open. The Chicago engineering societies with their prestige and far-seeing officers have made easy the path to the business man's council table. He will welcome them most heartily, but they must put upon themselves the burden of going to that table. The financial and business world needs the knowledge and judicial wisdom which the engineers' experience has given them.

The world is moving fast. It awaits no man's leisure. What formerly took five years to decide is now "signed, sealed and delivered" in as many months. If the engineers stay out of the development and it engulfs them the blame is on their shoulders.

Engineering Education for War-Time and Reconstruction Periods

ENGINEERS are needed as never before. They will be in greater demand as time progresses. Their qualifications must be higher, their application more intense, their devotion more single than ever. At a time when their numbers should be increasing to meet war-time and reconstruction-period demands the very fountain head, the engineering schools, are being drained toward dryness of both students and instructors by the exigencies of the war. True, important measures have been taken to keep engineering students at their schools by placing them in the Students Army Training Corps; but this has merely helped to lessen the decline in engineering students. Something is needed to increase the output.

Last year a number of engineering schools hastened graduation and provided a longer possible working period for undergraduates by cutting vacations and otherwise gaining time. That was good, but did not go far enough. It did point the way. Elsewhere in this issue there is outlined what Lehigh and Brown Universities are doing, not merely in their engineering departments but in all their courses as well, to speed up the preparatory period and get their students into the ranks of the fighters and workers for democracy. By cutting vacations and time devoted to examinations both these institutions make it possible for all their students to graduate in three instead of four years.

The change at these two colleges is most significant. It is needed for the reconstruction as well as for the war period. By the time normal conditions are restored the three-year courses will probably have been proved to be so practicable and desirable that many colleges will never go back to four-year courses.

Headshakers and doubting Thomases who question the feasibility of a three-year engineering course will be still more doubtful over the proposal for confining university instruction in engineering to two years, which was set forth in an address by a member of the Institution of Civil Engineers, quoted on p. 353 of this issue. The British courses in engineering, it appears, are only three years in length now. In proposing to cut them a third Mr. Silcock urges that when the schoolboy enters the university he should be treated as a man and made to work a man's day, exactly as is the case with the boy of 17 who goes from school to shop. The argument might well be extended to vacations as well. These are no times for short days and long vacations. If the school day were lengthened, the vacations shortened, the two weeks or more a year now given to examinations cut out, and, with all this, if the engineering and other college instruction were brought closer to the realities of living and working, it would be far easier than now to hold students for needed professional training of all kinds.

Mr. Silcock proposes that his suggested two years at the university be followed by three years of articled training under a member of the Institution of Civil Engineers. This is broadly similar to the coöperative courses in engineering which have been given for a dozen years at the University of Cincinnati. Like courses are to be introduced next month at Rutgers, as stated in the news section. Mr. Silcock would give the student his practical training in a lump, after the university work, while in the coöperative plan work and study alternate in two-week periods.

The coöperative plan has the material advantage of making the student a producer besides making an engineering education a possibility to many who would otherwise be denied a college course. Both advantages are important—doubly so in war-time.

If the regular engineering courses can be reduced from four to three years to meet war conditions, should not the coöperative courses be four years instead of five? The problem would be harder. The Rutgers plan cuts the vacation total to the bone, so no further saving is possible there.

The shortening of all college courses at Brown and Lehigh, the new coöperative courses at Rutgers and Mr. Silcock's arguments for a two-year university course for engineering students are signs of the new spirit of concentration and service in which not only educational but all other problems must be attacked and solved. To meet conditions we must have more engineers and better engineers, and that quickly.

Continuous-Span Bridges and Structural Efficiency

OF POLITICAL interest to the entire country as marking the reconstruction of a link in the main supply line of our now all-important steel industry is the rolling into place of the Bessemer & Lake Erie's new Allegheny River bridge two weeks ago. It also claims a place of note in engineering history. The operation put in service the second great continuous-span bridge of the present era. A new movement in bridge practice is definitely established by this structure, a movement toward economy of a higher type. Tendencies in the same direction have been clearly discernible in other fields of engineering work during recent years.

In the rise of continuous-span construction—signalized by the Sciotoville and Bessemer bridges and, far north toward Hudson's Bay, by the Kettle Rapids crossing of Canada's yet uncompleted grain-export route to Port Nelson—the deciding factor was economy of metal. It is a factor of ever-increasing moment. Evolution of design and progress in methods of fabrication and erection have steadily tended to cut down the cost differences between competing forms of structure to the base-level of difference in material consumed. As this process continues, both cost and service value are coming to depend mainly on structural efficiency—efficiency in applying material to specified duty. The future is sure to see structural efficiency acquire yet greater importance, and the line of progress marked out by the design of the three newest large bridges will be a permanent line of progress.

Present relations between production and consumption of materials emphasize economy of utilization in remarkable manner, and therefore afford peculiarly appropriate occasion for the introduction of the continuous-bridge type. However, though steel economy was the motive, war prices and delivery difficulties played no part in dictating the design. More general causes were active. Chief among them was the fact that a long-established distrust of the continuity principle has bit by bit disappeared before the influence of advancing design and construction methods.

Beyond the mere uncertainty of knowledge which this distrust represents, however, an uncertainty of tangible physical kind long stood in the way of free use of continuous-span bridges. Such bridges involve stress reversals, and these are objectionable with pin connections. The complete elasticity which a continuous bridge must have, in order to make it amenable to analysis, is vitiated seriously by pin-hole play when the forces on the pin reverse. During the years when pin connections were standard in American bridge practice, a continuous bridge was bound to be a structure of uncertain action, its stress distribution depending on the chance fit of the pins and their positions at no-load condition.

It is now many years since pin connections were abandoned for short spans; in the short-span field, however, continuous construction is not easily applied, because of difficulty in providing end anchorage. On the other hand, large bridges present such difficulties in the use of riveted joints that until late years pin connection remained universal.

Such recent works as the Fratt bridge over the Missouri with its long, full-riveted spans, therefore, helped to prepare the ground for long-span continuous bridges. It is significant that the Sciotoville bridge, the first of the three new structures mentioned, required spans of exceptional magnitude, and all its joints are riveted. In part for this reason the Sciotoville bridge is likely to remain the type expression of the new form of construction. The Bessemer bridge, having shorter spans—though presenting fully as difficult problems—might with still better reason be expected to have riveted joints. But its designer, departing from practice established by others, decided on partial use of pin joints, and succeeded brilliantly; the eyebar members which he was thus enabled to use increased the steel economy of his structure considerably.

That skillful engineering can apply continuous construction without being forced to understand restrictions such as abandonment of eyebars or equality of span length is illustrated by the Bessemer bridge. We have been taught that the very real obstacle of physical indetermination due to loose joints may be overcome in two ways. The development of practical riveted joints for bridges of even the greatest magnitude furnished one way; the perfection of bridge-building methods to the point where composite pin and riveted construction is feasible supplied the other.

Much has been made of pier settlement as a danger to permanent serviceability of a continuous bridge. Past writings of many kinds appeared to set up such anticipated settlement as a conclusive argument against the practical use of continuity. But as settlement even in serious cases is small—harmless, in view of the range of motion which the flexibility of a long span allows—probably this argument was never intended to be taken at face value. It seems to have been the outward evidence of a general doubt concerning the proper stress action of elastically continuous structures. Engineers did not feel certain that the shop and the erector would produce a bridge identical in strain-and-stress behavior with that represented on the design sheet and in the computations.

Today this uncertainty no longer exists. The successful construction of the three continuous bridges taught us several important truths. We now know that the adjustment operation is mechanically simple. We also have learned that the required end reactions can be attained with great precision. Finally, we are told that observed and computed deflections checked very closely; and this is perhaps the most important fact of the three, as it proves definitely that our theory of continuous structures is adequate.

Time and engineering progress have dealt with some other difficulties that stood in the way of favorable consideration of continuous bridges by practical engineers. Design calculations for such structures are difficult and tedious, and up to relatively recent years this fact was a very real hindrance. The former practice of proportioning bridge members by stress-reversal formulas—appropriate, if anywhere, only in the designing of detail—acted in the same direction, through reducing the gain obtainable by the continuity action. Current views regarding expansion and contraction, which led to a preference for sectionalized structures, gave an apparent advantage to simple-span and cantilever over continuous construction, but they no longer are determinative; placing a distance of 1200 ft. between anchorage and expansion joint, as in the Bessemer bridge, is today's iconoclastic reversal of yesterday's opinion.

With smaller obstacles thus cleared out of the way, the Sciotoville, Bessemer and Kettle Rapids bridges dispose of the crucial difficulty of uncertain stress action by supplying vital and decisive knowledge on adjustment and stress action. They open a new future to continuous-span construction, and do much toward establishing the type as a definite fashion of design. And because each separate instance was decided essentially on the score of saving in steel, the doctrine of structural efficiency—economy of material—receives significant emphasis.

Roads in Base Section of American Forces Require Widening and Resurfacing

Heavy Traffic by Motor Trucks and Artillery on Practice Marches Necessitates Continuous Maintenance—Many Narrow Roads Were Never Designed for the Traffic They Are Now Carrying

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record
Photographs by Engineering News-Record

As a result of the occupation of large areas in France by troops of the American Expeditionary Forces, existing roads are being subjected to more intensive traffic than they have ever before carried. It goes without saying that upon the highways in the advance section a heavy burden is imposed, and in a former article I dealt with the work of our Road Service in this forward zone (see *Engineering News-Record* of May, 16, p. 953). Somehow or other, it seems to be taken for granted that the problem of road reconstruction and maintenance is confined to the territory immediately behind No Man's Land. I know that before I arrived over here I had a rather vague idea that most of the engineering activity of the armies was confined to that mysterious region known as "the front." This is by no means the case. In so far as the duties of the highway engineer are concerned, the road problem begins at the French seacoast and extends from there to the trenches.

Let us remember that the trenches which American divisions are now occupying and the west coast of France are separated by several hundred miles. Let us remember, also, that practically all of our supplies must be delivered from America at French ports and transported across this stretch of land, several hundred miles long, before they can reach the combatant troops. We have, therefore, a main base of supplies some 3000 miles across the Atlantic, certain places in France where ships carrying these supplies dock, and then this distance of several hundred miles between the marine terminals and the points of ultimate consumption. This condition of affairs is one which has a very decided bearing on the upkeep of the roads.

Of course, most of our material is shipped across France by railroad to the advance section. Yet, strung along in a wide band between the seacoast and central France is village after village crammed full of American troops. There are our cantonments, artillery training camps, forestry camps, aviation grounds, storage depots, railway yards, ordnance dumps, repair shops—all of these groups marking the way between our base sections and forward lines. The creation of these *new* centers of population along our lines of communication, together with the practice of billeting American troops in scores of old French villages, means, of course, a substantial increase in motor-truck traffic on roads which were never designed for such hard usage as they are now receiving. Between towns where two-wheeled oxcarts proceeding at a snail's pace used to supply the bulk of the traffic, one sees now lines of motor trucks hauling supplies, or big powerful French camions pulling 6-in. field artillery pieces in long convoys.

In the immediate vicinity of the newly built American docks in the base section traffic has become specially heavy. Motor trucks are arriving and departing constantly on short-haul trips. Then, too, the presence of American troops in this region means a great deal of fast moving traffic in the form of army cars carrying officers from one point to another. The roads subjected to this ever-increasing heavy traffic are for the most part either dirt or plain macadam, and labor, material and plant for maintenance or reconstruction are extremely scarce.

THE SUPERINTENDENT OF ROADS WAS FORMERLY CHIEF ENGINEER, BUREAU OF HIGHWAYS, BOROUGH OF MANHATTAN, NEW YORK CITY

I have recently returned from a tour of inspection of the roads in a base section which includes the new docks which our engineer troops have built, huge storage depots and railway yards, a big artillery training camp and scores of other important army centers. The superintendent of roads for this section is a major of engineers who was formerly chief engineer of the Bureau of Highways of the Borough of Manhattan, New York City. According to his analysis of the situation the road work in this base section includes the construction of 20 km. of new roads, the complete maintenance of 120 km., and the partial maintenance of 180 km., resulting in a total of 320 km., or, roughly, 200 miles of road. This mileage includes all of the standard types of French road: (1) *Route nationale;* (2) *route départmentale;* (3) *chemin de grande communication;* (4) *chemin d'intérêt local* and (5) *vicinal ordinaire.* These roads, all of the water-bound macadam or plain gravel types, vary in width from 6 or 7 m. in the case of the *routes nationales* to as little as 3 m. for the *vicinaux ordinaires,* which correspond, roughly, to an American dirt road through farming country. At the present time the French Government, through the *Ponts*

FIGS. 1 AND 2. TWO VIEWS ALONG FARM ROAD THREE METERS WIDE NOW BEING USED BY OUR FIELD ARTILLERY TROOPS FOR PRACTICE MARCHES — NOTE MARKS LEFT BY CATERPILLAR TREADS OF BIG GUN CARRIAGES AND NOTE ALSO HOW TRAFFIC HAS BEEN FORCED OUT ON SHOULDERS AND INTO DITCHES

FIG. 3. PASSAGE OF AN ARTILLERY TRAIN THROUGH A SMALL FRENCH VILLAGE HAS BROKEN CULVERT

et Chaussées and Departmental forces, is endeavoring to do the bulk of the maintenance on the national roads and departmental roads; but as American Army activities over here in France expand, much of this work will have to be taken over by the United States.

The problem of the American road force in the base section resolves itself mainly into the upkeep of existing roads, and the building of new roads in the camps, and can be classified under the three main heads of (1) ordinary maintenance, consisting mainly of the filling in of holes; (2) repairs, involving complete jobs of resurfacing, and (3) widening. Many of our centers of military activity in the base section are off the lines of main traffic, with the result that ordinary farm roads are the only existing routes available for motor-truck traffic and practice marches and maneuvers by field artillery with their heavy guns, limbers and camions. In the case of the *vicinal ordinaire*, or farm road, the width of only 3 m. is insufficient for the passage of two trucks, and sometimes, in fact, difficult even for the passage of a single line of the wide artillery carriages. Fig. 1 shows how a practice march of field artillery over these narrow dirt highways chews up the shoulders of the road, even when running on caterpillar treads, whose marks are clearly shown. In Fig. 2, note from the wheel tracks how traffic has been forced off the road into the ditches. Then, too, these artillery loads, amounting to 7 tons per axle, must be hauled over culverts never designed for such weights, with results such as those shown in Fig. 3. This broken culvert was a cement pipe about 1¾ in. in thickness and a foot or so in diameter. For such traffic the demand is for wider roads, or for turnouts at frequent intervals. Then, too, the intersections of these farm roads are not designed for vehicles with the long wheel bases that now use them, so that our road force must build out the edges to provide easier curves at crossroads.

In the case of the wider trunk roads the foundation course of *blocage* ranges from 6 to 10 in. and the top course is about 6 in. On the town and village roads which are now receiving so much American traffic, however, the top course is very thin, often only about 3 in., and often there is no special foundation course. The problem of maintenance of these routes is complicated by the difficulty of getting crushed stone delivered on the job. It is necessary to resort as far as possible to local material. Fig. 4 shows a gravel and sand pit opened up by the American Army Road Service.

FIG. 4. SAND AND GRAVEL PIT BEING WORKED BY SPANISH LABOR, DIRECTED BY A DETAIL OF ONE OF OUR ROAD-BUILDING REGIMENTS

It is being worked by Spanish labor under the direction of a detail of our roadbuilding regiment. Owing to the scarcity of materials it is not always possible to resurface roads with as thick a course as would be desirable.

For handling the work of complete and partial maintenance on the 320 km. of roads in the base section, the force at the time of my visit consisted of the superintendent of roads, two other engineer officers, 225 men of a roadbuilding regiment, and a labor force of 350 Spaniards. The equipment included one passenger automobile, one light truck, 18 dump wagons, three road rollers, 36 animals and 20 motor trucks, including a number borrowed from the French, a certain proportion of which, however, were always in the repair shops.

The superintendent of roads of the base section recently prepared a statement of the personnel and equipment which, in his opinion, the needs of the work in his district for the next six months demanded. It was essentially as follows: One superintendent of roads, 12 engineer officers, 1500 men. As for plant desired, the following were the chief items: 12 steam rollers, 50 5-ton back-dumping motor trucks, eight light trucks, 85 wagons, 188 animals, 15 sprinkler wagons and a large quantity of small tools such as wheelbarrows, forks and shovels. During the next six months estimates have placed the amount of crushed stone needed at 50,000 tons, or about 5000 carloads. For purposes of inspection there were requested eight passenger automobiles, and nine motorcycle side cars. The present situation in France with respect to the available supply of men and materials is one which has resulted in the giving of priority to requisitions from the zone of the advance section, so far as road matters are concerned.

The labor problem is being partly solved by the employment of Spaniards, who receive 11 francs per day of 8½ hours. These men must house and feed themselves—not a difficult matter, in view of the proximity to the work of a large city and innumerable villages. The army, however, must transport these men, generally in motor trucks, to and from their jobs, or at least to and from points where transport by electric railway is possible. The Spaniards, I am told, are proving to be fairly good workmen. They are not under military control and can be hired and fired as desired. Their wages of 11 francs daily is big money for them, and most of them seem eager to hold down their jobs by doing a real day's work.

This is not the case, however, with some of the Chinese labor which has been imported into France and is under French control. I had an opportunity of seeing a great many hundreds of newly arrived Orientals on French jobs in and near a large camp. They were sprawled along the roadsides, asleep, or squatting in groups, talking. Several times I saw these fellows start out with wheelbarrows containing one-third of a real load. They would take a dozen steps, and then, when the French boss of the gang had his back turned, would flop down on their knees, lay their heads in the bodies of their wheelbarrows, and go to sleep. The only sign of real activity among these Chinamen was along a roadside where a gang, presumably on work of spreading crushed stone, was clustered around a cage containing two canary birds—which I suppose were the mascots of this crew. They had brought the birds out on the job with them, hung the cage on the limb of a tree, and were sitting around like an audience at an open-air theatre, watching their pets jump from one perch to another of the wire cage. I understand that there is some clause in the agreement under which these Chinese "work" which prevents their being disciplined.

After seeing them in action I could appreciate the humor of the scene enacted the next day in the office of the American major of Engineers who has charge of our road work in the base section. The door opened and a French officer entered. After greeting the major, he said, "At last I can help you with labor for your road work. I have 500 Chinamen I will let you have."

The superintendent of roads shook his head in a decisive, unmistakable negative.

"Mon Dieu!" exclaimed the Frenchman. "Why do you not want them?"

"Mon Dieu!" countered the American. "Why do you want to get rid of them?"

One of the solutions of the labor problem for road work in the base sections may be the use of French refugees from areas in the zone of the armies. A bureau has been established in Paris, and the plan is to organize labor battalions which will be paid, housed and policed by American interests.

"There is this difference between the road problem of the French and American armies," said the superintendent of roads of the base section. "For the forward areas the French have their special engineer troops, while in the zones of the rear the work is attended to by civil organizations, such as *Ponts et Chaussées*, and departmental and *vicinal* services. The equivalent of our own *Ponts et Chaussées* is 3000 miles

FIG. 5. FRENCH ROAD OF "GRANDE COMMUNICATION" TYPE—USE BY ARTILLERY IS PRODUCING RUTS AND HOLES WHICH WILL SOON NEED ATTENTION

away, in the form of the Federal Office of Public Roads and the various state, county and town highway bureaus. The result is that the American Expeditionary Forces must perform work, in the territory they take over, with their own roadbuilding forces, while this job for the French is done by an existing and thoroughly well-organized department of civilians, leaving the army engineers free for work immediately behind the front.

FIG. 6, 7 AND 8. WIDENING A NARROW ROAD LEADING INTO AN IMPORTANT AMERICAN ARMY CAMP — MOTOR TRUCKS DELIVER CRUSHED STONE TO THE JOB, AND THE STONE IS SPREAD ON EITHER SIDE OF THE ORIGINAL ROAD

To get results equivalent to those of the French we must look forward to a considerable expansion in the American roadbuilding personnel in the regions back from the advance section."

One rather difficult job which the road service is handling is the maintenance of a road leading to our new docks. This route is, in places, flanked by houses which extend flush with the edges of the road, so that at some points there is no opportunity for widening. The traffic of motor trucks to and from the docks is very heavy, and all that can be done is to throw crushed stone into the holes which develop in the road surface. In one place, to secure better drainage, it was necessary to tunnel under a barn, for these buildings form regular walls along both sides of the road, there being no room even for sidewalks. This road is particularly difficult to maintain, because in addition to the almost endless stream of traffic it carries it is frequently inundated during high tide, being fairly near the water. Under conditions of lighter traffic the superintendent of roads in the base section told me he would like to try some form of road construction other than macadam—possibly a concrete road—but inasmuch as this is practically the only route leading to our new docks, the traffic over it continues in a steady stream all day, and sometimes far into the night, and there is no opportunity for putting the road out of service for reconstruction, even during a comparatively short period. About the only thing that it is possible to do with this road under present conditions is to fill up the ruts with broken stone as they develop.

On another rather heavily traveled road the maintenance force in the base section accomplished the feat of making a 3-ft. fill under traffic. This fill consisted of sand and gravel, and was spread in thin layers between the movement of vehicles.

Particularly in the vicinity of large American army camp centers for the repair of machinery and equipment, it has been necessary to do a considerable amount of road widening. Figs. 6, 7 and 8 give an idea of the problem and how it is being handled. This road was originally only about 3 m. wide and of macadam construction with rather thin surfacing—too thin, in fact, to stand up under the motor-truck traffic which it will soon have to bear. The widening process consists of adding about one meter of paved surface to each shoulder, and putting on a top surfacing of about 4 in. Crushed stone for this job has been delivered by motor trucks as shown in the pictures. This process of widening generally is not complicated by the necessity of providing new drainage ditches, inasmuch as French practice generally places these ditches some distance from the shoulders of the road, leaving space for additional paved widths when this becomes necessary.

In another route which had to be resurfaced, the following scheme of construction has proved efficacious: The road is first scarified, and upon it a layer of hard blue stone 4 in. thick is spread. For binder material there is added a thin layer of soft limestone. The surface in this condition is then watered and rolled with a 17-ton roller until it becomes sloppy. Then a layer of sand is sprinkled over the top and the material rolled again. When it dries out this form of construction makes a hard, smooth road.

One of the difficulties of the road work in this base section is the matter of securing an adequate supply of crushed stone. Plans are under way for the opening up of several quarries by our forces. The rights for these must be secured from the French property owners, and it is not always an easy task to reach an agreement on prices, particularly as the negotiations must be conducted in French, either directly or through interpreters.

Of course, the local quarry owners are losing no opportunities of getting as high prices as possible for their rock, and our superintendent of roads is equally vigilant in his efforts to secure a fair price from the standpoint of the American Army. I happened to be present during one of these quarry-buying negotiations, and I noted particularly that the major of engineers who is looking after our interests in this section has learnt enough French to judge of values when stated in francs, and to say *"trop cher"* when an exorbitant figure is quoted to him.

In addition to the road work proper, there is the matter of bridges. Our work did not include the building of any new bridges, for in this region there are numbers of structures of all types, some of them built more than 100 years ago. In walking over one of the oldest bridges (suspension type, 250-ft. span), in the wake of a two-wheel ox-cart, the floor could be seen to rise and fall in a regular wave, and there was a noticeable creaking and swaying of the bridge. The road superintendent is responsible for keeping our troops off such structures as he considers to be unsafe. Among his many other duties he must examine these old bridges and reach a decision as to whether or not they are suitable for use.

On the subject of types of roads over here the superintendent of roads in the base section has authorized me to quote him as follows:

"The French national and departmental roads are masterpieces of thoroughly first-class construction. The alignment, gradients, curves, drainage and roadbed are perfection, and the water-bound macadam surfaces have been developed to the last degree in both use of materials and execution of the work. Water-bound macadam, however, has proved in France, as in the United States, to be unfit for heavy motor-truck traffic, and many millions of dollars would have been saved and much greater efficiency in the motor transport service would have resulted had these loads received a hard-paved surface before the war. This is the lesson to be derived from an intensive study of the roads of France."

Appropriates Supposed Powers of Highways Council

District Capital Issues Committee Refuses Permission to Finance Highways Approved by Washington Body

WHILE Government bulletins, apparently official, have described the United States Highways Council as having power to authorize, or prevent all highway activities, it would seem that this is not the case. The District Capital Issues Committee with headquarters at Cleveland, Ohio, is reported to be exercising authority which was supposed to belong only to the Highways Council. Following is a review of the proceedings of the committee, including extracts from its correspondence with the Huron County, Ohio, Board of County Commissioners, which tend to justify the above report. In any event, the announced policy of the Highways Council to consider and rule only on work investigated and recommended by the various state highway departments, is not being followed.

Application having been made for permission to issue bonds to the amount of $123,000, and the Huron County Commissioners having furnished a map, showing the projects in question and the connecting improved roads, as requested by the Capital Issues Committee, an assistant secretary of the committee was sent out to inspect the roads. After completion of his inspection he requested the commissioners to discontinue certain improvements, particularly that upon the No-God Road for which bonds had already been provided and the contract let. The county officials agreed to postpone the work with the understanding that the requested $123,000 bond issue for Main Market Road No. 1 be allowed.

Upon receipt of a letter agreeing to this, and after stating that the officials had evidently misunderstood his request, the assistant secretary wrote: "My suggestion was not only that the improvement on the No-God Road be not made, but also that no other roads be improved or paved, whether or not the money for such purposes be in fund, unless and until the Capital Issues Committee be given a chance to pass upon the improvements as being military necessities. In other words, the Capital Issues Committee is desirous that Huron County confine its improvements to Inter-county Highway No. 1, if such application eventually be approved, or at least to carry on no further improvements without the sanction of the committee. I trust that a letter formally agreeing to the above suggestions will be forthcoming promptly, as I have no doubt that until it is the formal opinion from Washington with regard to Inter-county Highway No. 1 will be delayed."

To this the county commissioners replied that they had no intention of doing other road work than that on Main Market Road No. 1. This, however, was not satisfactory to the assistant secretary, who made out and requested the commissioners to sign the following form, omitting, however, $25,000 of the amount for which they had applied.

"We, the commissioners of Huron County, do hereby agree between ourselves and the Capital Issues Committee that if the improvement of Main Market Road No. 1, and the issue of bonds in the amount of $98,000 for the improvement of same be allowed by the Capital Issues Committee, for and in consideration of said fact, we, the said commissioners, will not improve any other road in the Huron County or repave the same, whether the money be in fund or not, without the prior approval of the Capital Issues Committee or its district committee at Cleveland. This promise is not to prejudice our right to proceed with work which has already been started and for which a bond issue is not necessary. It is to be understood that no work has been started within the meaning of this agreement unless the actual physical construction has been commenced.

The county commissioners signed and forwarded this agreement substantially as written, inserting, however, the $25,000 omitted by the committee.

So much for the incident in Huron County. The extracts from the correspondence speak for themselves. Other reports, however, go to show that this is not the only place in Ohio where the District Capital Issues Committee has interfered with important road work. Ohio industrial plants which use the highways point out that this seems peculiar in view of the fact that an analysis of the entire road requirements of the State of Ohio has been submitted to the United States Highways Council, and that the council has approved the building of certain roads, as being of military necessity and importance. Inasmuch as the United States Highways Council is composed of representatives from the War Department, the Department of Agriculture, the Railroad Administration, the War Industries Board and the Fuel Administration, it might be assumed that its recommendations had been made after careful consideration of all of the conditions.

Why the District Capital Issues Committee has seen fit to disregard the recommendations of the council is not stated, but it is alleged that upon two projects, namely, the Cleveland and Youngstown road, and a portion of the motor parcels post route between Columbus and Toledo, both of which have been approved for construction by the Council, the District Committee has refused to authorize the issuance of bonds. The latter road has been particularly requested by the Post Office Department, and the other is a main thoroughfare southeast of Cleveland.

Two-Year Engineering Course Urged by British Engineer

Followed by Three Years Under Member Institution of Civil Engineers, Would Lead to Associate Membership

UNIVERSITY work for only two years, followed by three years' training under articles to a practicing engineer was advocated by E. J. Silcock in a paper introducing a general discussion of "The Training of Engineers" before the summer meeting of the Institution of Water Engineers held recently in England. The university work should be preceded, Mr. Silcock said, by a good general education at a public school. The speaker had no objection to the teaching of Greek and Latin in the earlier period of public school work, but declared that the last two years should be concentrated on natural sciences, mathematics—including at least calculus and the relation of triangles—and two modern languages.

Entering the university at the age of about 17 years, the student "must be taught to regard himself as no longer a schoolboy, but a man who has really commenced work. He should be held strictly to regular hours from 9 a.m. to 5:30 p.m., with one hour for luncheon, on five days of the week, and from 9:30 to 1:00 p.m. on Saturdays. In addition, there would be a certain amount of "overtime" evening work in the form of note-taking and study.

Vacations would have to be cut materially from present practice. A month in the summer and a week each at Christmas and Easter were suggested. Examinations should be cut to a minimum, the speaker said, but a feature should be made of test papers. Two examinations in the two-year period were suggested. One of these would be by the university, at the end of the first year, and the other by examiners appointed by the Institution of Civil Engineers. The second examination might include the theoretical part of the examination for admission as an associate member of the Institution.

The university studies would have the following general scope: (1, 2, and 3) elementary chemistry and physics, and also geology, each with special reference to engineering; (4), surveying instruments, their use and adjustment; (5), strength of materials and methods of testing; (6) hydraulics—"to be very, very fully treated"; (7) calculation of stresses in structures and graphical methods; (8), dynamics; (9 and 10), general principles of various prime movers, and instruction in their selection and testing; (11), transmission of power. Drawing should not be given at all in the university, but reserved for the office. Surveying and leveling are also best taught in practice. There should be no attempt to teach mere manual dexterity in the handling of machine tools.

"So far as is known," said Mr. Silcock, "there is no university or technical school curriculum which covers the ground suggested above, and if there were it would be quite impossible to do justice to it in two years without modifying the usual timetable."

Articles and Apprenticeship

Practical training for the engineering student would comprise three years of being articled to a corporate or full member of the Institution of Civil Engineers. During the first two years of this period the student would be engaged chiefly in drafting work, interspersed with visits to works in progress and practical fieldwork on surveys and leveling. The third year would be given more to outdoor work of various practical kinds in positions of some responsibility.

During the whole three years of apprenticeship the student in training should devote himself for at least two nights a week in winter to continuation classes, preferably at the university at which he took his two years' course; or, failing this, at "some good technical institute or school." At the end of his third year of articled training, when the student would be, say, twenty-two years old, the "embryo engineer should be able to earn a salary sufficient to keep him." The final step in his training would be to take the second part of the examination for associate membership in the Institution of Civil Engineers at, say, 23 or 24 years of age, which test should be of a more practical character than the one now given.

Discussion of Mr. Silcock's paper by about a dozen men brought out no large and united volume of opposition to his educational scheme. One or two thought the proposed two years' course would be too grinding. Two or three urged that considerable shopwork should be included in the training of an engineer, particularly a water engineer. One dissented somewhat strongly from the proposal to exclude drawing from the university course, urging that it afforded relaxation from intensive mathematical studies. Words were spoken by one or two against cutting the usual three-year university course to two years. These speakers referred to the

current American practice of having a course extend to four years. Mention was made of the fact that at Birmingham University the professor in civil engineering had provided a four-year course for those who wished more than three years. One speaker voiced appreciation of the general requirement of American universities which makes English a compulsory subject.

Following the discussion, Mr. Silcock, speaking of the objections that had been offered to his proposal for a two years' university course, said he had proposed reducing the college period because boys do not work half their time in college, and get into habits which give them an altogether wrong idea of what their future life will be. "If a lad went straight from an ordinary public school into a mechanical engineering shop, or into an office," Mr. Silcock said, "he would have to put in those longer hours. Why should he not put them in if he went into a technical college?"

Mr. Silcock's address and an abstract of the discussion which ensued may be found in the London *Surveyor* for July 5, 12 and 19.

War-Time Changes in Education at Three Institutions

Brown and Lehigh Cut All Courses to Three Years —Rutgers Starts Five-Year Co-operative Engineering Courses

ENGINEERING and all other courses at both Brown and Lehigh universities will be comprised within three instead of four years, beginning in September. In each case there will be three instead of two college terms, and no curtailment in the actual instruction given. These are wartime measures. At the same time, Rutgers College, New Brunswick, N. J., will open coöperative courses in civil, electrical and mechanical engineering, extending through five years. The announcement of these courses says nothing about war-time conditions, but for convenience they will be outlined further on in connection with reviews of the three-year courses at Brown and Lehigh.

Three 14-Week Terms at Lehigh

Under the four-year system at Lehigh there were two terms of 17 weeks each, or 34 weeks in a year, which gave a total of 136 weeks in four years. Deducting eight weeks devoted to examinations during the four years left 128 weeks for instruction. Under the new plan there will be three terms of 14 weeks each devoted entirely to instruction, or 126 weeks of instruction for the entire course. Examinations will give place to "tests" throughout the term. There will be vacations of a week at Christmas, another week in the spring, and eight weeks in summer, but part of the latter "will be devoted by engineering students to summer schools in practical work."

While considering it primarily a war-time problem, Brown University announces distinct recognition of the need of fitting college courses to meet reconstruction problems as well. Thus it says in its announcement that it is adapting itself "aggressively to the national service in the war and in the readjustment to follow."

There will be three 16-week terms at Brown in all courses, including those in the college for women. The engineering courses were rearranged in accordance with the program just outlined, before changes in the other courses were announced.

Prospective occupation is to guide the student at Brown in choosing, toward the end of his freshman year, any one of the six courses leading to the degree of A.B. or Ph.B. Having made this choice, he will work on the principal of "concentration," which is said to have given satisfaction in the schedule of studies previously followed for the Ph.B. degree. Apparently, attendance during the summer term will be optional at Brown. In other words, the student may take four years for a course if he wishes.

Five-Year Coöperative Course at Rutgers

Rutgers states, in announcing its five-year coöperative course in civil, mechanical, and electrical engineering, that it will follow the plan "developed and used at the University of Cincinnati during the past twelve years." The course will lead to the B.Sc. just as it does with the present four-year course at Rutgers. There will be a vacation of a single week at Christmas and one of two weeks late in the summer. Both of these vacations will be taken from college rather than from shop time, thus giving 26 weeks of industrial work and 23 weeks of study.

About 80 students will be taken in the new five-year courses during the first year. There will be a common program of study for all first-year students. Manufacturing concerns in the vicinity of New Brunswick, the announcement states, prompted the college to establish the new coöperative courses.

For the benefit of those not familiar with the University of Cincinnati coöperative plan, the following two sentences may be quoted from the Rutgers announcement:

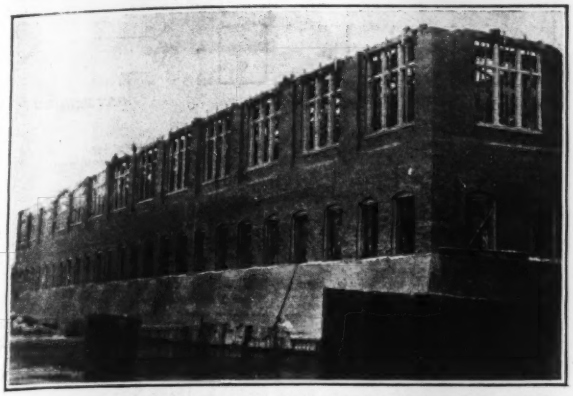
"Students are arranged in definite pairs, and the members of the pair alternate every two weeks so as to give a continuous one-man service in a definite place of employment. They receive the same rate of pay as other workers of like grade, and are under the same conditions and regulations of employment."

Build Walls and Roof Before Second Floor

Thus Providing Permanent Housing in Which Floor Concrete Could Be Safely Placed In Cold Weather

RUSH conditions at the Menasha Paper Co., at Ladysmith, Wis., required last winter a new machine shop building at very short notice. Work was started in the late autumn, and cold weather caught the construction early. In order to avoid the necessity for temporary housing to provide temperature warm enough for the laying of the floor concrete, it was decided to carry the walls of the two-story building up to the roof and place the roof before putting in the intermediate reinforced-concrete second floor.

The building, shown in the view, is 38 x 206 ft. in plan, and two stories high. On Oct. 24 the contractor started driving steel sheet piling to close the site along the adjoining Flambeau River. Footing concrete was started five days later, closely following the excavation



SHELL PLACED BEFORE SECOND FLOOR TO PROVIDE FOR WINTER CONCRETING

and piledriving. The latter was completed Nov. 5, and the rig was dismantled and yarded out of the way, except the engine which was retained for handling building materials. Footing concrete was completed Nov. 12, and the brickwork on the walls started the same day, being carried thereon clear to the roof. A horizontal slot was left in the brick walls at the second floor level, the wall above that being carried up in pilasters between the large windows.

Bricklaying was finished Dec. 4, and steel roof trusses which had just arrived were in place on the following night. Redwood roofing and steel purlins were finished Dec. 14, and the prepared roofing Dec. 19. Meanwhile, forms for the second-story machine-room floor, which was a 13-in. slab with two heavy concrete girders running the full length of the building, were being erected. Reinforcements and the templets for bolt holes, anchor bolts, etc., were placed by Dec. 27, the floor was completed by Dec. 31, and the installation of the machines was started Jan. 3.

The plans were prepared by J. P. Jacobson, consulting engineer, Minneapolis. The work was done by Siems, Helmers & Schaffner, St. Paul.

Framing Plans Simplify Fieldwork on Cincinnati High School

Single-Sheet Framing Plan Gives All Data Required by Form Builders and Steelworkers, Condensing Information Embodied in Several Sheets of Architect's Drawings

BY JOHN T. SULLIVAN
Covington, Ky.

TIME consumed in field computations by construction superintendents and foremen was greatly reduced on the concrete buildings for the East Side High School, Cincinnati, O., by special framing plans made from the architect's drawings. These framing plans gave, on one sheet for each floor, all the dimensions necessary for laying out and framing the formwork. Using the architect's drawings for the same purpose would have made necessary the consultation of several drawings and the making of numerous computations and measurements. Supplemented by steel lists, also specially prepared for field use, these framing plans reduced the time consumed in framing forms and in preparing reinforcement to a fraction of the period required when working directly from the architect's drawings.

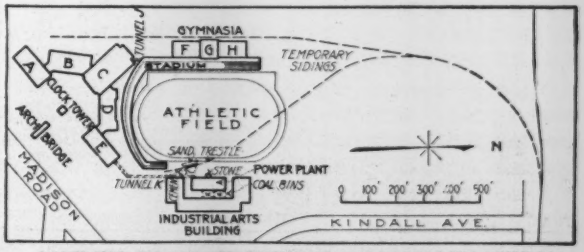
Costing some $1,500,000, the East Side High School work comprises 10 buildings and other structures shown by the outline plan. Concrete construction is employed throughout. Buildings A to E and the clock tower were made one construction contract and all other structures were made another contract. It is with the second contract that this article deals.

FRAMING PLANS CUT TIME AND DECREASE ERRORS

It was decided by the contractors to make framing plans for the concrete work and to keep the architect's drainings for office use only. The reasons for this decision were (1) the size of the scale used and the size of the buildings necessitated larger architects's drawings, which were too bulky to use for field erection; (2) the number of dimensions shown on the architect's drawings had to be very limited in order not to crowd out other branches of the work shown thereon; (3) to obtain the sizes of beams, columns or footings necessitated not only looking these up on the plans but also in the schedules shown in the book of specifications; (4) too much time would be lost in adding up rows of dimensions in order to obtain the one dimension which was desired; (5) while the foreman would be adding up a row of dimensions his gang would be standing around waiting for orders.

Therefore the framing plans, which replaced the architect's drawings in the field, were reduced from the scale 4 ft. to the inch, which was used by the architect, to the scale of 8 ft. to the inch. These plans contained every possible dimension which could be needed for the erection of the work, and gave also the sizes of all beams, columns and slabs on any particular floor; gave the sizes and location of all openings, angles, anchor bolts, etc., and gave all sections which were necessary to show the elevation of the various beams and slabs.

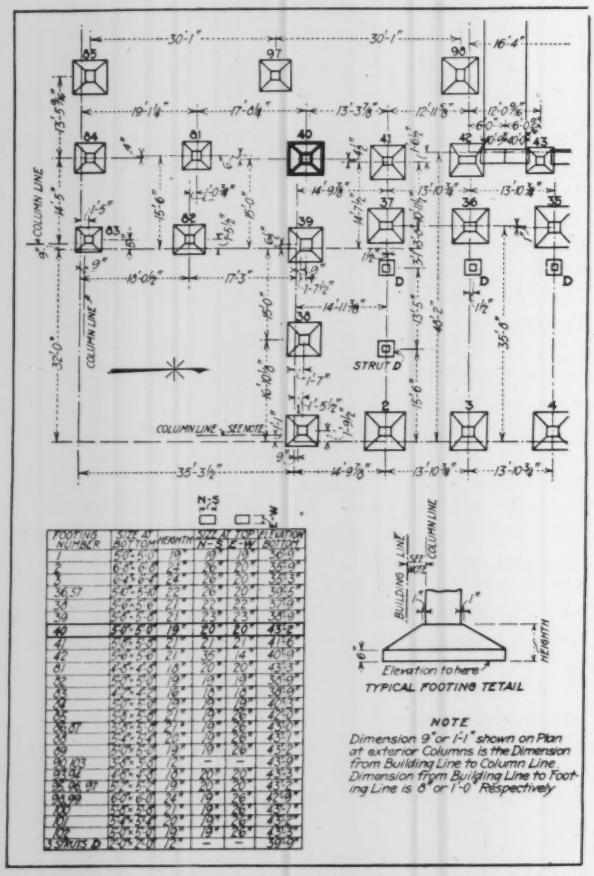
To complete each framing plan required about one



OUTLINE PLAN OF CINCINNATI EAST SIDE HIGH SCHOOL BUILDINGS

week, after which time it was submitted to the architect for check and approval. Making a so-called framing plan is not a new idea. It is, however, unusual to make a framing plan which is complete in itself and not merely a retracing of the architect's drawings, omitting all other branches of work shown thereon which may not pertain to the contract in question. Plenty of dimensions are needed in a framing plan; this statement cannot be too strongly emphasized.

In order to show the advantges obtained in the field in the erection of a footing, consider footing 40, shown on the footing framing plan. The first step will be to locate the center lines. The north-south center line is given as 15 ft. from the north-south building line of the offset. Or, if it should happen that footing 81 had been previously laid out, the north-south center line of footing 81 could be shifted 6 in. east immediately to form the north-south center line of footing 40. The east-west center line of footing 40 could be laid out from the building line for the south face of the south wing by adding the dimensions 19 ft. 1¼ in. plus 17 ft. 8¼ In., a total of 36 ft. 9½ in. This same center line could be laid out from the building line for the north face of the south wing by adding the dimensions 12 ft. 11⅝ in. plus 13 ft. 3⅞ in., a total of 36 ft. 3½ in. The next steps in order are to obtain the size of the bottom, the size of the top, the height and the elevation of the bottom of the footing. All this information is obtained


COLUMN LINE
STRUT D
TYPICAL FOOTING TETAIL
NOTE
Dimension 9" or 1'-1" shown on Plan at exterior Columns is the Dimension from Building Line to Column Line. Dimension from Building Line to Footing Line is 6" or 1'-0" Respectively

FOOTING FRAMING PLAN AND SCHEDULES GIVE ON ONE SHEET ALL DATA FOR LOCATION AND FORM FRAMING

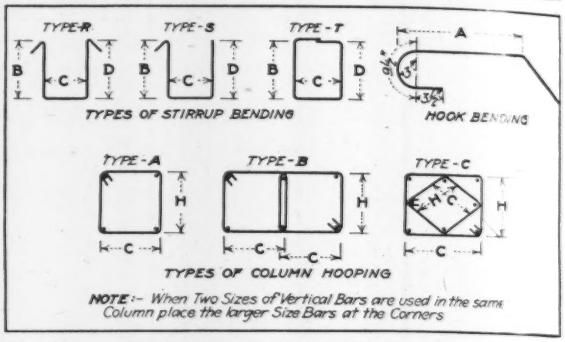


DIAGRAM EXPLAINS ALL BENDS NAMED ON STEEL LIST SHEET

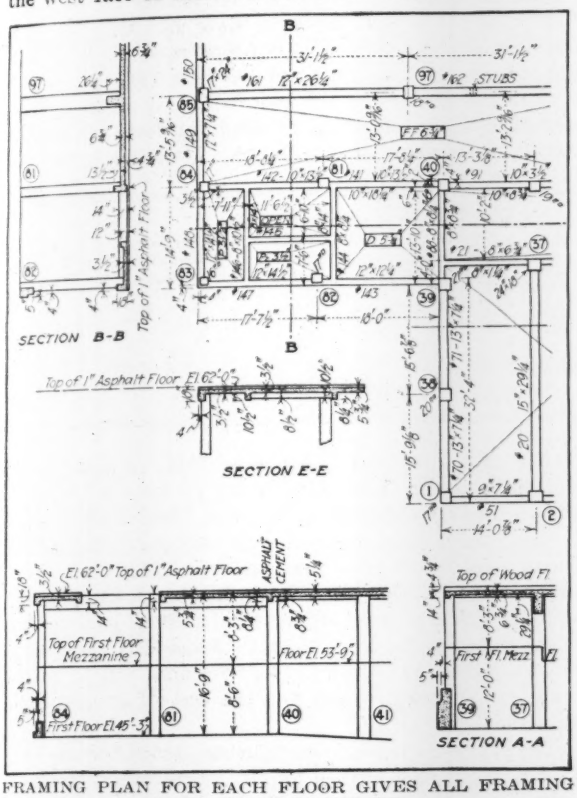
from the schedule at the bottom left-hand corner of the footing framing plan. There are four such schedules, extending across the bottom of the plan, of which the drawing shown is only a small portion. These separate schedules take in the footings located directly above them. The steel for each footing can be obtained directly from a steel list which will be described later.

Now, compare this work with that required if the architect's drawings were to be used in the field. To begin, it would require more time to calculate center lines from the architect's foundation plan. Having obtained the center lines, it would then be necessary to refer to the footing schedule in the back of the book of specifications, p. 10, where the size of the bottom and height of the footing are given. The next step would be to refer to the column schedule, p. 9 of the specifications, in order to obtain the size of the top of the footing. This would be calculated by finding the size of the column which rested on the particular footing, and then adding 2 in. in each direction to the column dimensions. The next step would be to refer to the architect's drawing showing the longitudinal section of the building in order to obtain the elevation of the bottom of the footing. By using the framing plans all these extra steps are eliminated in the field, and in case a check is desired it is an easy matter to run through the procedure very rapidly and with only one drawing to handle.

The framing plan for the foundation walls shows the elevation of all the foundation walls, sections through them, openings for windows, beam pockets, places where angles occur, and also all lines of offset for limestone ashlar work.

The framing plans for the various floors show the sizes of all columns, beams and slab thicknesses. This enables the carpenter foreman easily to list his sizes of beam sides, joists, floor panels, shores, etc. One advantage to be noted is in the erection of columns. Column 40, shown on the second floor framing plan, may be taken as an example. The first step in the erection of this column would be to set up the column form in position and plumb it and brace it on all four sides. After this is done the next step would be to get an elevation on the column with an engineers' level, and establish the cut-off line for the floor above. The next step would be to mark off the pockets where the beams frame into the column. Each beam which frames into column 40 has been dimensioned on the framing plan in such a way as to show how far from the corner of the column

the beam pocket should be started. That is, beam pocket 91 starts 4 in. east from the north-west corner of the column. If the dimension 4 in. were not given, it would be necessary for the carpenter to figure back along beam 91 to column 41, where he would find that the west face of beam 91 was flush with the west face



FRAMING PLAN FOR EACH FLOOR GIVES ALL FRAMING DATA FOR THAT FLOOR

of column 41. Then, by calculations of some length, the difference between the west face of column 41 and the west face of column 40 could be computed, and finally the required dimension 4 in. would be obtained. The time wasted in the field on supposedly small items like this is enormous.

The reinforcing steel which was required was listed on 10 x 16 in. sheets. From these were made blueprints which were bound together with a cover sheet containing a key to the various bends and types. The sheets were numbered, and at the head of each sheet was indicated where the steel listed thereon was to be placed. Each item was then listed.

Taking for example C-83 as listed opposite Tag 1, it can be seen that C-83 stands for Column 83. At the top of the sheet it is shown that this column helps to support the second floor. The size of the column is 16 x 16 in. The steel which makes up the column consists of Tag 1; namely, four ¾-in. round bars 23 ft. 9 in. long. The total number of ¾-in. round bars is also four, since there is no other member the exact duplicate of Column 83. The bars have been ordered cut to length, as is shown by a "cut from" column. The type is shown as "St" meaning straight, and the bending diagram shows that the C portion is the only bending column made use of in this case and therefore indicates that no hooks or bends occur in these bars. Tag 2 gives the hooping material, which consists of 22 ¼-in. square twisted rods 4 ft. 9 in. long, to be cut from 40 ft. material. The hoops are of the A type as shown on the cover sheet, while the bending diagram columns indicate a 4-in. hook on each end, with dimensions C as 12 in. and H as 12 inches.

Taking a more complex example, B-1-20, as listed opposite Tag 7, it is assumed that B-1-20 represents two second-floor beams, 1 and 20, which are exact duplicates. The steel consists of that shown opposite Tag 7; namely, four 1-in. square twisted straight bars per beam with a 10-in. hook on each end, as shown in the bending diagram columns; tag B consisting of one 1¼-in. square twisted straight rod 36 ft. 9 in. long per beam with a 10-in. hook on each end; tag 9 consisting of three 1-in. square twisted bent rods 33 ft. 9 in. long per beam with the dimensions of the hooks and bent segments, as shown in the bending diagram columns as follows: (Hook) 10-in. hook on the end; (A) distance from the hook to the first bend, 2 ft.; (B) Inclined segment, 3 ft. 10 in.; (C) lower straight part, 25 ft. 4 in.; (D) inclined segment, 3 ft. 10 in.; (E) top straight part to hook, 2 ft., and (Hook) 10-in. hook on the end. The (H) column shows the depth of the trussed rods as 32 in. Tags 10 and 11 show the bending diagrams for the other two bent bars which occur in each beam. Tags 12 and 13 give the number and sizes of the stirrups. The key to the type is shown on the cover sheet. The remark column shows how the stirrups are spaced.

The system of plans and steel lists described was worked out by the Roos Bros. Construction Co., Cincinnati, O., contractors for Group II of the high school buildings. Garber & Woodward, Cincinnati, O., were the architects.

Wisconsin Board Rejects Reproduction Cost Less Depreciation

UNLESS a public utility has not only earned the sum represented by depreciation in excess of a fair return on the original investment, but has also returned the same to the investors, retaining no depreciation reserve represented by assets, reproduction cost less depreciation cannot be used as the final measure of fair value for rate-making purposes, states the Wisconsin Railroad Commission in an opinion rendered in the case of the Milwaukee Electric Railway & Light Co., as reported in *Public Utilities Reports*. The owners of the utility, says the commission, are entitled to have their prudent and honest investment kept intact until returned to them. Where reproduction cost less depreciation is used as controlling in determining fair value, unless the amount earned to provide for depreciation is returned to the investors, it will not usually earn a return sufficient to constitute a fair return on the investment.

Interest on reserve assets held in the business, furthermore, will not, it is held, bring the return up to a fair figure unless the rate of interest equals the rate constituting a fair return. On this point the commission says:

"If the reserve assets are held in the business and the reproduction cost less depreciation is used as a basis for valuation, a return upon such reproduction

cost less depreciation at the normal rate, plus interest earned upon reserve assets, would be less than a fair return upon the investment unless a rate of interest were actually earned upon such reserve assets equal to the rate which constitutes a fair return for the property as a whole. Where reserve assets actually earn less than the fair rate of return upon the investment as a whole, the only way that occurs to us in which investors can obtain a fair return upon their full investment is by earning a higher rate on the cost new—less depreciation than would be required if the investment, as already discussed, were used as a basis. Unless the rate of return on the cost new less depreciation is to be enough higher than the rate which should be applied to the full investment to bring the total return, which is made up of the return on cost new less depreciation and interest earned on reserve assets, the reserve being provided on a straight-line basis, up to an amount which would constitute a fair rate of return on the investment, we see no way in which the investor, under such a method of valuation, would secure a fair return upon this investment unless it is to be assumed that the amount earned for depreciation can be withdrawn from the business, and the investment thereby diminished."

To show that this cannot properly be assumed, the commission quotes from the decision in the Knoxville Water Co. case that "the company is not bound to see its property gradually waste without making provision out of earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired, so that at the end of any given term of years the original investment remains as it was at the beginning."

More Data on Filter Sand Growth at Grand Rapids

Increase of Sand Grain Incrustation Rapid During Past Year—Lime Cost Increases but Quality Decreases

ANOTHER year's data on sand growth in the filters of the Grand Rapids (Mich.) water softening plant, now available from the latest annual report of Walter A. Sperry, chief chemist, indicate a rapid increase during 1917. Three articles describing the experience with sand growth at Columbus, O., Grand Rapids and McKeesport, Penn., appeared in the *Engineering News-Record* of May 3, 10 and 17, 1917, pp. 250, 304 and 351. As Mr. Sperry's report is not to be printed the main table is repeated, with the 1917 figures added. The 1916 figures are also somewhat changed. The report states that the sand samples seem to have been selected from a spot not representative for sieving tests. Thickness of such sand coating for the four years ending August, 1917, was 0.040, 0.064, 0.115 and 0.187 mm. The sand increased in size over the original 2.1 times in 1914, 2.56 in 1915, 3.57 in 1916 and 4.82 times in 1917. The specific gravity of the original sand was 2.651. It had decreased to 2.508 in 1915, to 2.424 in 1916 and to 2.383 in 1917. In 1916, 25.2% passed a 0.659-mm. sieve and there were no smaller grains. By 1917 only 1% passed the same sieve and 95.1% passed the next highest sieve of 1.057-mm. mesh. All passed a 2.124-mm. sieve in 1915 and 99.4% in 1917.

Costs of chemicals are reported as increased, consistent with the difficulties of obtaining them as regards quality, production and delivery. Lime has increased 39.5% over 1916 and 55.8% over 1915, in addition to a drop in quality from 88% water soluble CaO in 1915 to 83% in 1916 and to 77% last year. Alum has increased in cost 11.9% as compared with last year and 22.7% as compared with the year before. The total operating costs of the plant have increased 24.1% over 1916 and 62.8% over 1915. Per million gallons the operating costs for 1914, 1915, 1916 and 1917 are $11.33, $12.86, $14.87 and $18.84. This includes wages, chemicals, power house water, and the cost of supplies and repairs.

CHARACTERISTICS OF FILTER SAND AT GRAND RAPIDS

	Effective Size Mm.	Uniformity Coefficient	Per Cent Acid Soluble
Sand as specified	0.35–0.44	Less than 1.65	5.0
Original sand	0.27	1.61	6.5
After washing and scraping	0.35	1.36	6.5
After use Oct., 1913	0.42	1.33	23.0
After use Aug., 1914	0.51	1.22	45.2
After use Aug., 1915	0.58	1.12	57.6
After use Aug., 1916	0.75*	1.04*	68.0
After use Aug., 1917	1.05	1.00	77.5

* Interpolated from curve for years 1913–17, inclusive.

The average chemical constituents in parts per million in the river and filtered water, respectively, were as follows: Turbidity, 16 and 0; total hardness, 228 and 87; alkalinity 194 and 46, incrustants, 34 and 41; magnesium 18.5 and 10.4. Bacterial counts were respectively 1980 and 9, with a maximum of 45,000 and 300 and a minimum of 100 in the river and 0 in the filtered water. The average wash water used was 2.2% and the average length of run between washes was 19 hours, with maximum and minimum of 49 and 6, respectively. The number of typhoid fever cases, 50 per 100,000, was the lowest since the plant was put in operation in 1912.

FIVE YEARS' GROWTH OF FILTER SAND AT GRAND RAPIDS

Long-Span Concrete Beams Should Have Fixed Ends

Method Given By Which Computation of Rigid Frame Design May Be Readily Made

By W. S. Tait

Vice President and Chief Engineer Tait Engineering Co., Chicago

MOST building ordinances make no provision for fixed ends of concrete beams. Thus, the standard design requirement for a single span concrete beam supported on concrete columns at each end provides that the beam shall be designed for a moment of WL/8 at the center. Where brick bearing walls are used instead of concrete columns this requirement is approximately correct, but is far from true where the beam is supported by concrete columns more or less fixed to the beams. Little or no provision is made to allow for the bending to which the column must be subjected as a result of the fixity of the connection with the beam. This method of design provides a beam about 50% too strong and in long-span construction columns which may be exceedingly weak.

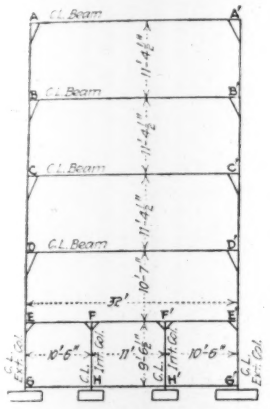


FIG. 1. OUTLINE OF FRAME TO BE INVESTIGATED

When the present design rules were formulated, concrete beams of more than 30 ft. in span were very rare, and no adequate analysis of the distribution of the bending moments between the column and beam was available for the practicing engineer. As concrete construction has progressed, however, the spans used have been gradually increased until column spacings up to 60 ft. are now sometimes encountered. With spans of any magnitude it is essential that due provision be made for the bending moments due to the fixity of the columns and beam connection. A good example of a fixed beam design in reinforced concrete is the new factory for the Illinois Watch Case Co., at Elgin, Ill. This building is four stories and basement in height, approximately 215 ft. in length and 34 ft. in width. In the basement, the columns are placed about 12 ft. centers in each direction, but in the upper stories it was desirable to provide a clear floor with no columns except in the exterior walls. The exterior columns are spaced 11 ft. 7 in. on centers throughout the length of the structure,

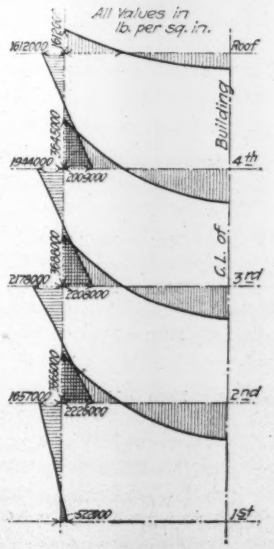


FIG. 2. DIAGRAM OF MAXIMUM MOMENTS

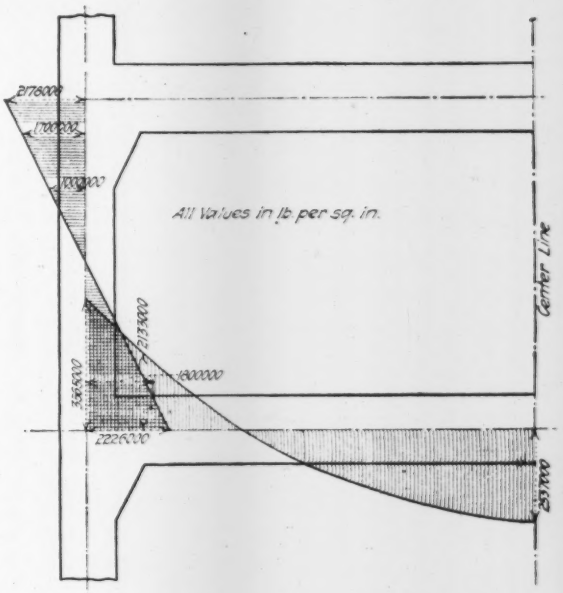


FIG. 3. ENLARGED DIAGRAM OF MOMENTS AT CONNECTION

and beams span across the building between these columns. The floor consists of a one-way reinforced-concrete slab. The first floor is of flat-slab construction. All of the floors are designed for a live-load of 200 lb. per square foot.

The distribution of bending moments through the columns and beams was obtained by the analysis known as the method of slopes and deflections. In this analysis the bending moment is found in the beam at the intersection of the center lines of the columns and mid depth of the beam and in the column just above and just below this intersection.

The general equation for the moments at this intersection is as follows:

$$2E\frac{I_B}{l}\left(2\theta_A + \theta_B - 3\frac{d}{l}\right) = C$$

where

E = modulus of elasticity of concrete;

I_B = moment of inertia of the beam;

l = length of beam;

θ_A, θ_B, etc. are angles of deflection at points A, B, etc. of member under load;

d = amount of deflection of far end of members;

C = resisting moment at joint.

In making this analysis the joint is considered to be the point of intersection of the column center and the horizontal line of the mid-depth of the beam.

Since we do not wish to find the amount of the deflection the term E may be omitted, also since each end of the beam is equally rigid there will be no deflection d at the far end of the member. Therefore, the bending moment in the beam at the joint becomes

$$I_B/l\left(2\theta_A + \theta_B\right) = C \qquad (1)$$

Now let $K = I/l$, $Kc = K$ of column, $K_B = K$ of beam, $n = K_B/K_C$.

M_{AB} designates the moment at point A in member AB; M_{BA} designates the moment at point B in member

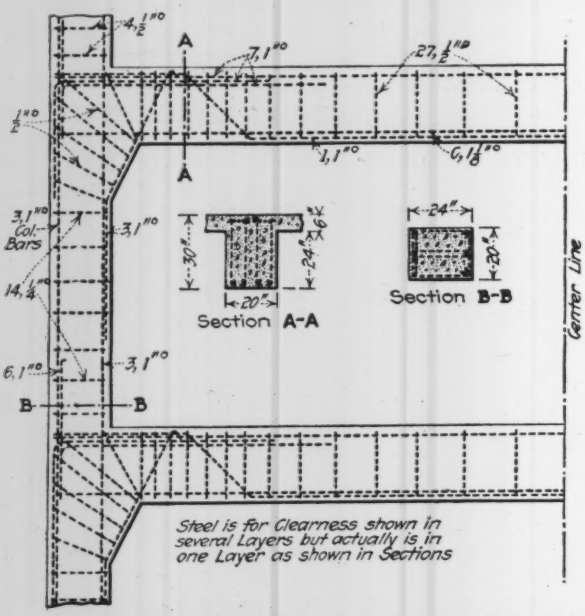


FIG. 4. REINFORCING DETAILS AT RIGID CONNECTION OF BEAM TO COLUMN

TABLE II. SUMMATION OF MOMENTS ALL IN M INCH LBS.

Cases	1	2	3	4	5	6	7	
Points	All Floors Loaded	3rd and 4th Loaded 2nd No Load	2nd and 4th Loaded 3rd No Load	2nd and 3rd Loaded 4th No Load	4th Loaded 2nd and 3rd No Load	3rd Loaded 2nd and 4th No Load	2nd Loaded 3rd and 4th No Load	Max.
Beams Neg. Roof..	1592	1588	1612	1503	1608	1518	1530	1612
4	3625	3645	3540	1449	3560	1392	1369	3645
3	3688	3595	1413	3590	1404	3525	1401	3688
2	3540	1350	3463	3565	1270	1369	3483	3565
Pos. Roof	1028	1032	1008	1117	1012	1002	1090	1117
4	2375	2355	2460	726	2440	783	815	2460
3	2312	2405	762	2410	771	2475	774	2410
2	2460	325	2537	2435	905	806	2517	2537
Columns								
MAB	1594	1590	1612	1498	1608	1520	1495	1612
MBC	1850	1544	1540	706	1617	1022	395	1944
MCD	1884	1578	807	2178	473	1782	1070	2178
MDE	1422	319	1657	1348	565	266	1595	1657
MEG	—357	—42	—426	—336	—114	—28	—410	—426
MBA	1778	1725	2009	746	1956	910	980	2009
MCB	1738	2208	674	1418	930	1744	325	2208
MCD	2142	1044	1806	2226	703	1102	1885	2226
MED	443	128	509	522	197	112	490	522

BA. Now $I_B/l = K_B = nK_C$ and equation 1 becomes

$$nKc\left(2\,\theta_A + \theta_B\right) \mp C$$

In the beam θ_B is equal and opposite to θ_A so that the moment in the beam at the joint becomes

$$nKc\;\theta_A = C.$$

Also, we may write unity for K_C and simplify this equation to $n\,\theta_A \mp c$. Similarly, the moment in the column can be written $2\,\theta_A + \theta_B$. The diagram Fig. 1 shows the structure under consideration.

From the simultaneous equations 1 to 5 in Table I the moments at each joint in the beam and columns can be obtained. Have obtained $M_{CC'}$ for instance in the beam the moment at the center of the span equals $WL/8 - M_{CC'}$.

Before solving these equations values must be obtained for n. We must first, therefore, prepare approximate designs from the beams and columns and obtain values of I/l for each. Using these approximate values, the moments are obtained considering each floor loaded. From the moments thus obtained the beam and column sections may be designed. It is now necessary to obtain the correct value of I/l for the design, and since the arrangement of steel in the beam and column is not the same throughout their length equivalent constant moments of inertia which would give the same results as the varying values of these moments of inertia must be calculated. From these constant moments of inertia the correct values of n can be obtained and a new solution for moments made. If the design used above in obtaining these moments of inertia provides fairly closely for the moments now

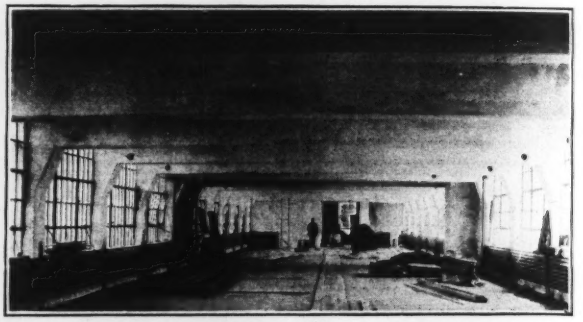


FIG. 5. IN ELGIN WATCH FACTORY 34-FT. CLEAR SPAN BEAM RIGIDLY FRAMED TO COLUMNS

TABLE I.

Beam Moments	Column Moments Below Beams	Column Moments Above Beams	Σ of Moments At Joints
1. $M_{AA'} = n\theta_A - \frac{WL}{12}$	$M_{AB} = 2\theta_A + \theta_B$		$M_{AA'} + M_{AB} = 0$
2. $M_{BB'} = n\theta_B - \frac{WL}{12}$	$M_{BC} = 2\theta_B + \theta_C$	$M_{BA} = 2\theta_B + \theta_A$	$M_{BB'} + M_{BC} + M_{BA} = 0$
3. $M_{CC'} = n\theta_C - \frac{WL}{12}$	$M_{CD} = 2\theta_C + \theta_D$	$M_{CB} = 2\theta_C + \theta_B$	$M_{CC'} + M_{CD} + M_{CB} = 0$
4. $M_{DD'} = n\theta_D - \frac{WL}{12}$	$M_{DE} = 2\theta_D + \theta_E$	$M_{DC} = 2\theta_D + \theta_C$	$M_{DD'} + M_{DE} + M_{DC} = 0$
$M_{EF} = -8600$ in.-lb.	$M_{EG} = 2\theta + 0,$		$M_{EF} + M_{EG} + M_{ED} = 0$
5. $\left(\frac{WL}{100}$ Flat Slab Moment$\right)$	No Moments @ G	$M_{ED} = 2\theta_E + \theta_D$	i.e. $M_{EG} + M_{ED} = +86000$

Summarizing the above:

1. $\frac{WL}{12} = n\theta_A + 2\theta_A + \theta_B = n\theta_A + 2\theta_A + \theta_B$

2. $\frac{WL}{12} = n\theta_B + 2\theta_B + \theta_C + 2\theta_B + \theta_A = \theta_A + n\theta_B + 4\theta_B + \theta_C$

3. $\frac{WL}{12} = n\theta_C + 2\theta_C + \theta_D + 2\theta_C + \theta_B = \theta_B + 4\theta_C + n\theta_C + \theta_D$

4. $\frac{WL}{12} = n\theta_D + 2\theta_D + \theta_E + 2\theta_D + \theta_C = \theta_C + 4\theta_D + n\theta_D + \theta_E$

5. $86{,}000 = 2\theta_E + 2\theta_E + \theta_D = \theta_D + 4\theta_E$

found, it will be unnecessary to recalculate the moments of inertia from the revised sections. The next step is to solve the equations 1 to 5 for varying members of floors loaded and from a tabulation of the results obtain the maximum moments. Table II is a tabulation for this case.

Figure 2 is a diagram of the moments in the structure and Fig. 3 is a large scale diagram for one story from which the moments at the edges of the brackets may be obtained. Fig. 4 shows the design used for one of the frames. After obtaining the maximum moments and also the column loads the various members can be designed. Fig. 3 shows the diagram of maximum moments.

In designing the columns for direct load and bending, care must be taken in considering the column section just above the floor, as this is the critical point. The reason for this is that it will be observed that the moment is as high at this location as anywhere in the columns, and we have the bare column section acting at this point without any bracket.

This building was erected in the autumn of 1917 for the Illinois Watch Case Co. of Elgin, Ill. George Morris was the architect and Charles Geirtz & Sons, contractors, executed the construction. The design for the reinforced-concrete structure was prepared by the Tait Engineering Co. under the personal direction of the writer.

Land Reclamation Would Provide Work and Homes For Hosts of Veterans

Irrigation and Drainage of 20,000,000 Acres Would Care for Million Families in Agricultural and Allied Pursuits — Water-Power Development Incidental to Irrigation Would Save Fuel and Aid Transportation

By Arthur P. Davis
Director United States Reclamation Service, Washington, D. C.

AT THE close of the great war in which we are engaged the United States will probably have more than three million men under arms and perhaps an equal number engaged in the manufacture of munitions and in other war industries, nearly all of whom must have other employment soon after the cessation of hostilities. Most of these men will have been drawn from lines of industry which are equally necessary to the welfare of our people and the conduct of the war; namely, agriculture, mining, manufacture, transportation, trade, etc., and the places thereby vacated will have been filled for the most part by the use of machinery, by women, and by boys and girls who have entered gainful occupations earlier than they normally would have done, in order to meet war conditions. Few of these people will be willing to relinquish their employment and the independence it insures, nor is it fair that they should be required to do so. It will be necessary to absorb six million able-bodied men into the ranks of industry, and this cannot be done without extensive preparations well in advance.

A similar problem, of much less magnitude, was presented at the close of the Civil War in 1865, but the vast public domain in the West was able to absorb the discharged soldiers, for at that time "Uncle Sam was rich enough to give us all a farm." The pending problem cannot be so met, for the number of men to be cared for will be several times greater and the arable public domain has passed into private hands and is mostly occupied.

Foreign Countries Working On Reconstruction

The importance of this problem has been keenly appreciated in foreign countries for some time, and extensive legislation has been proposed, and in many cases passed, looking to the provision of employment and homes for those whose best years have been given to the defense of our liberties, and the United States should not be a slacker in performing its part of this problem.

Owing to its great resources, the United States can fairly be called upon to shoulder a portion of this burden for Italy and other European countries with dense populations whose resources are inadequate to discharge these functions properly, and prevent great suffering, waste and perhaps disorder, which always accompany extensive unemployment.

Australia has already appropriated $100,000,000 to be used at the end of the war in the purchase and improvement of land for homes for its returning soldiers. In proportion to population this corresponds to $2,000,000,000 for the United States. Canada, Great Britain, France, Germany and Italy are undertaking similar measures.

In no case does this action take the form of charity or permanent gifts to the recipient. It is recognized that the discharged soldier will be able, and should be required, to earn his own living and carve out his own destiny, except in case of permanent disablement, for which hospitals and homes will be provided as a matter of course.

Careful consideration is being given to the training of those partially disabled and the provision of opportunities for their employment in industries in which they can be useful, but the able-bodied, uncrippled soldier will be equally helpless if opportunity for employment is not afforded him. Some of these men can doubtless for a time be profitably employed in the construction of public roads and in other public works which may be needed, but it would not be wise to carry such work beyond the limits of actual necessity, and they will furnish but a small fraction of the relief actually required.

It must not be forgotten that at the close of the war the United States will have the most colossal public debt ever known in the history of the world. Heavy

taxation must be continued for a long time to cancel this debt and reduce the interest as rapidly as possible. No funds should be devoted to any public works not actually needed, nor expended upon useless undertakings of any kind. There is, however, one class of public works which will not only return to the public in cash their entire cost, but will also be a permanent addition to the resources of the country and provide homes for a large number of those engaged upon their prosecution. This work is the irrigation of arid lands and the drainage of the vast areas of swamp lands within the limits of the United States.

Vast Arid and Swamp Areas Await Reclamation

The area of arid lands, in the 17 Western states, which can be irrigated by storage of flood waters and their diversion upon such lands is variously estimated at from 15,000,000 to 20,000,000 acres. This is sufficient to furnish homes to nearly a million farmers and an equal number of laborers, mechanics and other residents necessary to complete the communities that would be formed. A beginning on this work has already been made, the experimental stage has passed, and it has been demonstrated that this work can be made to increase production greatly and finally to return its cost to the Government from those who receive its benefits. Irrigation projects have an incidental value in the development of power to lessen the consumption of our diminishing fuel supply. They also benefit the country at large by the regulation of our streams and the abatement of flood damages in many cases. This work can be wisely and economically extended to solve its share of the reconstruction problem now pressing upon our country.

A still larger share may be performed by the reclamation of extensive areas of swamp lands. These are not only more extensive than the arid lands that can be reclaimed, but can, as a rule, be reclaimed somewhat more cheaply per acre. They are generally alluvial lands containing much fertility in the form of vegetable mold and of mineral plant food washed in from the hillsides through the centuries. Usually they are near the centers of population and are suitable for dividing into small tracts for intensive cultivation.

By making some preliminary investigations while the war is in progress we can prepare a program of feasible reclamation and development which will immediately employ millions of discharged soldiers and workmen directly upon the works required and indirectly in the manufacture of machinery and other supplies necessary for its prosecution.

The Hon. Franklin K. Lane, secretary of the interior, has proposed and is actively advocating such a program, and if supported in Congress will prepare a plan adequate for the solution of this problem when the need is presented.

Congress Provides $100,000 to Begin Studies

The sundry civil act, recently approved, contained provision for an appropriation of $100,000 "for an investigation to be made by the Director of the Reclamation Service of the reclamation by drainage of lands outside existing reclamation projects and of the reclamation and preparation for cultivation of cut-over timber lands in any of the states of the United States." That this appropriation was a deliberate adoption of a broad policy of reclamation is shown by the remarks of the chairman of the appropriation committee, who said:

"In nearly every state in this Union there are thousands of acres that can be reclaimed—some by putting water on them and others by taking water off them; some in a climate very much more favorable than others, and yet under the restrictions of existing law only land within the public-land states would be considered. I believe that the very essence of statesmanship consists not so much in undertaking to prevent movements as in directing and controlling them.

"We have built up a splendid Reclamation Service, the head of which is a man of very level-headed judgment. The committee on appropriations felt that it would be performing a distinct service, a needed and real service, if it gave to that bureau the money necessary to make a preliminary survey of the United States and to get from it information that will enable Congress intelligently to spend money in reclaiming the land rather than to be dependent upon the enthusiasm of advocates of particular projects in particular localities. The matter is of great importance. There have been many bills heretofore introduced in Congress for the drainage of swamp lands, bills for the further reclamation of arid lands, bills for the reclamation of cut-over and burnt-over land. We ought to have a real policy before we start into the expenditure of the millions that will flow from the adoption of any of these schemes under the various authorizations of the different bills which I have enumerated."

Some Irrigation Results Already Attained

The wide popular approval of Secretary Lane's proposition has aroused considerable interest in the details of the possibilities suggested, and a few words of elaboration may therefore be added. Under the provisions of the Reclamation Act, which has now been in operation about 16 years, the Interior Department has reclaimed about 1,650,000 acres, of which more than 1,000,000 acres were under actual irrigation in 1917, and the balance is mainly in the undeveloped portions of the farms occupied by settlers who are gradually putting this into cultivation. The projects already under way when completed will bring the reclaimed area to more than 3,000,000 acres, which is somewhere between 10 and 20% of the remaining area that can be reclaimed.

Many of these projects when irrigated require drainage. The Interior Department has 24 dredges and excavators at work at various points, digging drainage canals and laying drain pipe. The Reclamation Service has constructed about 450 miles of open drains and 160 miles of tile drains, and this work is still in progress. It has established the efficiency of the methods used, and has furnished a volume of detailed cost data which is very valuable in estimating new work.

The law requires the return of the money invested in these reclamation projects by the occupants of the land reclaimed. No interest is charged, and repayments are spread over a period of 20 years, with lighter payments at first, while the settler is struggling to bring the desert into production. There is no question of the capacity

of all of these lands to repay the reclamation charge. The experimental stage is passed, much has been learned in engineering, legal and practical lines, insuring the safety of more rapid progress in this reclamation work in the future without endangering public interests and with great benefit to the producing and home-making capacity of our people.

Water Storage and Power on the Colorado

One of the interesting features of the proposed irrigation development is the storage and diversion of the waters of the great Colorado River. Practically all of the easy and simple diversions have been accomplished, but great possibilities remain in storage in large reservoirs and the diversion of water through high-line canals, tunnels and other works of magnitude.

The Colorado River is an international stream, the waters of which are referred to in international treaties. It is also an interstate stream, and hence as a domestic problem is also of national character. Besides this, it is rated as a navigable stream, and the control of navigation has always been considered a national function. For all these reasons, therefore, the development of the Colorado River is not only national in character but is absolutely impossible of proper development by any other agency. The basin of this river contains nearly 3,000,000 acres of irrigable land in the United States, besides more than half a million in Mexico. Of the area in the United States about half is already irrigated, and the natural water-supply is entirely appropriated for this purpose. Large volumes of water run to waste, however, throughout the winter and particularly in the season of melting snows, May, June and July. By proper storage works these waters can be impounded and held for use during the low-water season, while the abatement of the floods thereby will incidentally benefit the lands along the river's course.

Power Development Would Conserve Fuel

Another incidental benefit is the regulation of this water for power purposes and in the cañons of this great river system are vast possibilities of power development much needed in the intermountain industries of mining and transportation. A portion of this power development can be made incidental to the construction of irrigation works, but the major portions are in the main independent thereof, although receiving great benefit from the regulation of the water in the irrigation reservoirs. Power possibilities on the Colorado River are very great, and though many years will pass before this can all be developed or will all be needed, the regulation of the water will immediately stimulate this development, which in turn will assist in bearing its share of the cost of the irrigation. All the power development thereby produced will check the consumption of fuel which has been advancing at such a terrifying rate during the past few decades.

Thirty years ago, or more, it was noticed that the consumption of coal had been, for several decades, doubling each 10 years. That is, the consumption was increasing in a geometrical ratio. Each succeeding decade has shown a continuation of this rate and recent years indicate a still greater acceleration. If this tendency continues, the accessible coal will be exhausted within a few decades. In addition to this, we have been using an enormous quantity of fuel oil, the consumption of which has grown rapidly. Many important oil fields have been nearly exhausted or greatly depleted, and the production has been maintained only by the rapid development of new fields. This cannot continue much longer, and the virtual exhaustion of our oil supply is a certainty in the near future. For all these reasons it is very important to encourage hydro-electric development in order to postpone the day of fuel shortage.

The Colorado basin is only an illustration of similar possibilities on many other streams of the arid region, most of which are interstate in character and afford great opportunities for irrigation and power development.

Vast Area of Swamp and Overflow Lands

The swamp and overflow lands are distributed widely throughout the Eastern and Central portions of the country, there being but little land of this character in the arid region. The inclusion of their reclamation in the general scheme will make the enterprise a national instead of a sectional one. The states containing the largest areas of swamp lands—in the order of area—are Florida, Louisiana, Mississippi, Arkansas, Michigan, Minnesota and Wisconsin, while nearly all the other states contain somewhat smaller areas. Table I gives the latest information regarding the areas of swamp and overflow lands in the United States.

TABLE I.—CLASSIFIED ACREAGE OF UNRECLAIMED SWAMP AND OVERFLOWED LAND

State	Permanent Swamp	Wet Grazing Land	Periodically Overflowed	Periodically Swamp	Total
Alabama	900,000	59,200	520,000	.....	1,479,200
Arkansas	5,200,000	50,000	531,000	131,300	5,912,300
California	1,000,000	1,000,000	1,420,000	.....	3,420,000
Connecticut	.....	10,000	20,000	.....	30,000
Delaware	50,000	50,000	27,000	200	127,200
Florida	18,000,000	.....	1,000,000	800,000	19,800,000
Georgia	1,000,000	.....	1,000,000	700,000	2,700,000
Illinois	25,000	500,000	400,000	.....	925,000
Indiana	15,000	100,000	500,000	10,000	625,000
Iowa	300,000	200,000	350,000	80,500	930,500
Kansas	.....	59,380	300,000	.....	359,380
Kentucky	.....	100,000	300,000	44,600	444,600
Louisiana	9,000,000	1,196,605	.....	.....	10,196,605
Maryland	100,000	.....	92,000	.....	192,000
Maine	156,520	.....	.....	.....	156,520
Massachusetts	20,000	.....	39,500	.....	59,500
Michigan	2,000,000	947,439	.....	.....	2,947,439
Minnesota	3,048,000	2,000,000	.....	784,308	5,832,308
Mississippi	3,000,000	.....	2,760,200	.....	5,760,200
Missouri	1,000,000	.....	1,439,600	.....	2,439,600
Nebraska	.....	100,000	412,100	.....	512,100
New Hampshire	5,000	.....	7,700	.....	12,700
New Jersey	326,400	.....	.....	.....	326,400
New York	100,000	100,000	329,100	.....	529,100
North Carolina	1,000,000	500,000	500,000	748,160	2,748,160
North Dakota	50,000	50,000	50,000	50,000	200,000
Ohio	.....	.....	100,000	55,047	155,047
Oklahoma	.....	.....	31,500	.....	31,500
Oregon	254,000	.....	.....	.....	254,000
Pennsylvania	.....	.....	50,000	.....	50,000
Rhode Island	.....	.....	6,000	2,064	8,064
South Carolina	1,500,000	.....	622,120	1,000,000	3,122,120
South Dakota	100,000	.....	511,480	.....	611,480
Tennessee	639,600	.....	.....	.....	639,600
Texas	1,240,000	1,000,000	.....	.....	2,240,000
Vermont	15,000	.....	8,000	.....	23,000
Virginia	600,000	.....	200,000	.....	800,000
Washington	20,500	.....	.....	.....	20,500
West Virginia	.....	.....	23,900	.....	23,900
Wisconsin	2,000,000	.....	.....	360,000	2,360,000
Total	52,665,020	6,826,019	14,747,805	4,766,179	79,005,023

The permanent swamp lands, or nearly two-thirds of the total, produce absolutely nothing, and besides being an eyesore are breeders of mosquitoes and malaria. The other classes produce slight revenue which is precarious and only a small fraction of what they are capable of producing, if reclaimed. They also are unsanitary. Many of these are interstate projects, lying

in part in two or more states, and are necessarily national in character.

Table II gives the area of stump and inferior timber land in acres for the different states. These figures furnish a fairly reliable approximation to the actual acreages. They were compiled from figures obtained from township, county and state officials, lumber and logging companies, and individuals well informed on these conditions in their localities. While the results of this survey are necessarily approximations, it is believed that the figures are as reliable as any it is possible to obtain upon these acreages.

State	Acres	State	Acres	State	Acres
Ala.	14,785,000	Mich.	11,686,000	Penn.	5,297,000
Ark.	13,893,000	Minn.	14,022,000	S. C.	8,994,000
Calif.	3,031,000	Miss.	13,203,000	Tenn.	7,833,000
Fla.	10,109,000	Mo.	8,900,000	Tex.	12,936,000
Ga.	20,141,000	Mont.	674,000	Vt.	2,070,000
Idaho.	676,000	N. H.	2,608,000	Va.	9,929,000
Ky.	3,222,000	N. J.	1,151,000	Wash.	3,330,000
La.	11,877,000	N. Y.	5,997,000	W. Va.	4,634,000
Me.	6,135,000	N. C.	12,745,000	Wis.	13,246,000
Md.	1,848,000	Ore.	3,537,000		
Total					228,509,000

Drainage problems are beyond the reach of individual effort and require the coöperation of public authority as well as public funds. This is true of large irrigation enterprises, but still more completely is it true of drainage. When an irrigation system is built any land owner not desiring to contribute his share to the public enterprise may decline to use and pay for the water unless some public means of compulsion, such as taxation, is exercised. But the managers of the irrigation system may refuse to furnish the water unless the land owner contributes his share, and the desirability of irrigation generally brings about coöperation in time as a matter of self-interest. Not so, however, with drainage. If the drainage system is operated at all it relieves all of the lands within the district drained whether their owners contribute or not, and there is no way of withholding the benefits from noncontributing lands. It becomes, therefore, imperative that drainage be done under some authority whereby all land owners shall be made to contribute their fair share for the benefits bestowed.

It cannot be expected that all the possibilities of reclamation outlined in this article will be undertaken immediately after the war, but reclamation of the most promising areas, one-third or one-fourth of the area upon which it is feasible, should be attempted. Assuming the reclamation of 5,000,000 acres of arid lands and 15,000,000 acres of swamp lands, these projects would provide direct employment for hundreds of thousands of returned soldiers on the construction of works which when completed would furnish homes for some of the same men and their families who would later return to the Government all the funds expended for their benefit. These 20,000,000 acres would make homes for nearly half a million families engaged in agricultural pursuits and an equal number in auxiliary occupations in the towns and villages which would grow up and the railroad systems which would be made necessary. Incidental benefits would be the encouragement of water-power development, thus conserving our fuel supply, the elimination of disease-breeding swamps and morasses of vast extent, and the amelioration of flood damages incident to water storage and stream regulation.

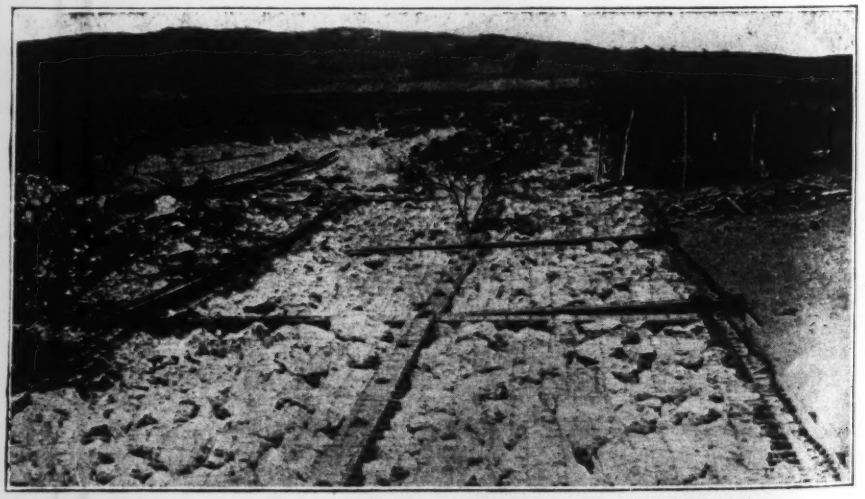
In addition to these material benefits, the plan proposed will help to solve to a large extent the social and economic problems of preventing the unrest and consequent danger to the tranquility of government, which would otherwise flow from the condition of having millions of unemployed with little prospect of entering gainful occupations or establishing homes.

Rock Cribs Blanket River Bank in California

Rapid Erosion on Colorado River Checked by Cribs Which Drop Over the Caving Face and Form Permanent Protection

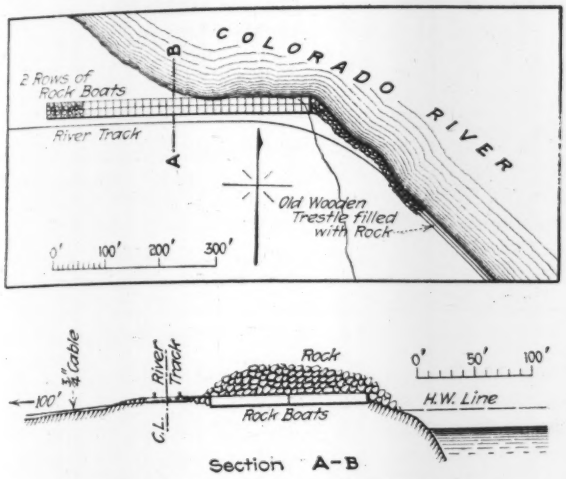
BANK protection consisting of shallow rock-filled cribs, or "rock boats," which drop over the face of the bank as it erodes, has been used at a sharp bend in the Colorado River near Needles, Cal., where the erosion threatened the line of the Atchison, Topeka & Santa Fé Ry. It was found that riprap would sink and afford no protection while the river was cutting so fast that no work of any value could be done along the face of the bank.

In this emergency it was decided to build cribs on the ground at a little distance back from the river. These were in two rows, lashed together at each corner by 16 ft. of ¾-in. wire cable, and anchored by similar cable to deadmen set 100 ft. back from the line of cribs. It was expected that when erosion began under the outer edge of the cribs in the first row they would drop into an inclined position and form a blanket protection for the



HOG FENCING HOLDS ROCK WHEN CRIBS TILT ON CAVING BANK

face of the bank, the cribs of the second row remaining practically horizontal. The engineers state that this plan worked successfully, the erosion being stopped at



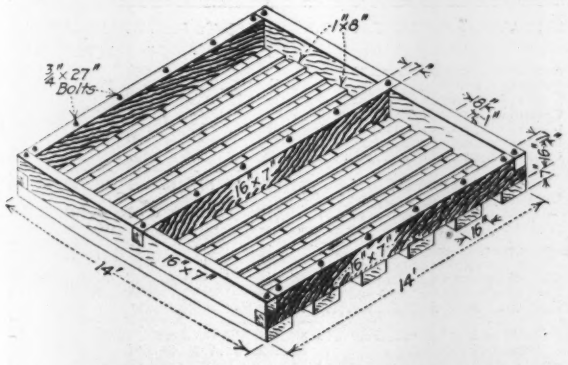
ROCK CRIBS STOP EROSION OF RIVER BANKS ON COLORADO RIVER

the row of cribs. The accompanying views show the cribbing in its original position and as it was placed finally.

Construction of the cribs is shown by the accompanying drawing, but the dimensions and sizes of the timbers used varied as second-hand material was utilized. The design is based on the use of old trestle stringers for the main timbers, with any available material for the bottom.

Rock filling was placed by hand and was covered with woven-wire hog fencing secured by staples. Additional rock was then piled on, to a depth of three or four feet.

Somewhat similar rock-boat cribs had been employed before, but with a size of 7 x 14 ft., built of old stringers and floored with 4 x 6-in. material. They were used largely under riprap to prevent its settlement. When tried for the protection of piers and banks it was found in some cases that when the boats were undermined the rock would roll out, so that the cribbing became of little value. For this reason a wire-mesh covering was adopted to hold the rock in place. Any available material was used for this purpose, but generally it was of about 4-in. triangular mesh with No. 6 and No. 14 wires.



2. SHALLOW CRIB OR BOAT FOR ROCK FILLING

Information as to the cribs and the bank protection at

4. ROCK-FILLED CRIBS FALL AS BANK CAVES, AND FORM PROTECTIVE MATTRESS

Needles has been furnished by G. W. Harris, chief engineer, and M. B. Clark, division engineer, of the Atchison, Topeka & Santa Fé Ry. (Coast Lines).

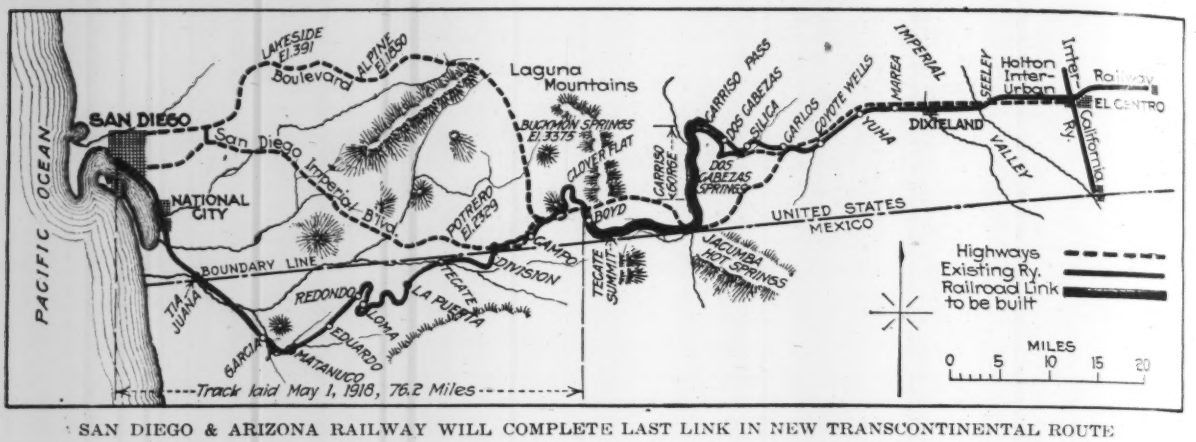
Will Complete New Railway Route to Pacific Coast

Line Rises from Sea Level to 3657 Feet, Then Falls to 50 Feet Below Sea Level—17 Tunnels in 12-Mile Gorge

APPROVAL granted by the United States Government for continuing the construction of the San Diego & Arizona Ry. will result in establishing a new transcontinental route having its terminal at the city and port of San Diego, Cal. It will give a direct line of about 220 miles from the Southern Pacific at Yuma, Ariz., to San Diego, as compared with the present indirect route of about 373 miles through Los Angeles, which is in part over the Southern Pacific and in part over the Santa Fé system. This is expected to benefit the city and the great irrigation district in the Imperial Valley.

The San Diego & Arizona Railway has in operation a line from San Diego east to Campo, 65 miles, of which 44 miles lie within Mexico. It has also 32 miles from Carriso Pass east to Seeley, whence connection is made by means of the Holton Interurban Ry. with El Centro, on a branch of the Southern Pacific. This end of the line lies in the Imperial Valley.

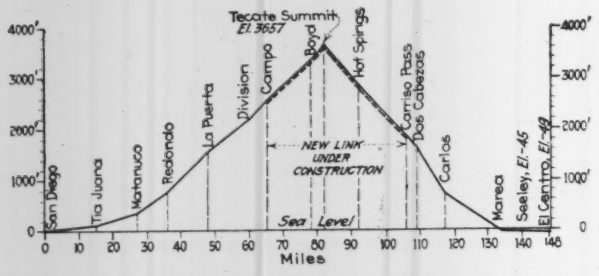
Completion of the 40-mile link between Campo and Carriso Pass will open a direct connection line between San Diego and the Southern Pacific system at Yuma. This 40-mile link, however, constitutes the mountain section and involves heavy construction work. It in-



SAN DIEGO & ARIZONA RAILWAY WILL COMPLETE LAST LINK IN NEW TRANSCONTINENTAL ROUTE

cludes also the summit of the line across the range, as shown by the profile.

Starting at approximately sea level at San Diego, the



PROFILE OF MOUNTAIN BARRIER CROSSED BY NEW RAILWAY TO THE PACIFIC

line will have a steadily increasing grade for 82 miles to a summit elevation of 3657 ft. on the Tecate divide. From this point it falls continuously, until at about 135 miles it reaches sea level and then continues to fall until at El Centro it is 49 ft. below sea level. The maximum grade is 2.2%. It will be seen by the map that considerable development is required to maintain the grade limit, including a loop at Clover Flat and a double loop near Loma, Mexico. The map shows also the San Diego and Imperial boulevard, with alternative routes between San Diego and Campo.

Construction of the new link is divided between the Twohy Bros. Construction Co., Portland, Ore., and the Utah Construction Co., Salt Lake City, 21 miles and 19 miles, respectively. The latter company's contract includes a 12-mile stretch in the Carriso gorge with 17 tunnels aggregating 13,412 ft. in length. On June 1 track had been laid for 108 miles, leaving 31 miles on which the grading was in progress. About 50% of this grading and 20% of the tunneling had been completed at that time. It is expected to have the line completed early next year.

D. A. Pontius is general manager of the San Diego & Arizona Ry.; E. J. Kallright is chief engineer.

Unit Costs for Setting Water Meters

BY ALLEN F. BREWER

Merion, Penn.; Lately Assistant Valuation Engineer, New Jersey Utility Commission

COST data pertaining to house meter setting are frequently of considerable interest to valuation and water-works engineers. To derive unit costs for such work in tabular form for reference in estimating on proposed installations or appraisals is of great value as a time saver. As a guide to arranging such a tabulation, the following data are presented. The costs quoted may be used with reasonable assurance as to correctness, inasmuch as they are averages obtained from current actual work.

To derive similar figures independently, it is only necessary for the engineer to tabulate the data from his own meter installation cost cards. The number of fittings required, together with costs by sizes, may be tabulated and averages arrived at for the number, total cost and average cost per meter set. It is well to add that fittings include tees, ells, caps, plugs and crosses, although the latter three are seldom used in house meter work. Average costs for couplings and seals may be likewise obtained. Meter costs are not considered, inasmuch as various types may differ considerably as to base price and discount.

Labor is assumed on a one-man basis, an average of 1¾ hours being derived for both carting and installation. Average percentages to be added for storeroom and tools have been derived, as have other unit figures, from actual observation of meter installation cost cards.

TABULATED UNIT COSTS FOR SETTING ¾- TO 1-IN. WATER METERS

Material	¾ in.	½ in.	¾ in.	¾ in.	1 in.
Average number of fittings	4.5	4.5	4.5	4.5	4.5
Average cost per fitting	$0.036	$0.036	$0.036	$0.042	$0.058
Cost of fittings per set	.162	.162	.162	.189	.260
Cost of stop cock	1.250	1.250	1.250	2.200	3.500
Cost of couplings	.300	.400	.500	.600	.800
Cost of coupling seals	.300	.300	.300	.300	.300
Cost of register seals	.050	.050	.050	.050	.050
Total cost of material	$2.062	$2.162	$2.262	$3.339	$4.910
Cost of storeroom, 3 per cent of cost of material	.062	.065	0.68	.100	.147
Labor					
Average man-hours per set	1¾	1¾	1¾	1¾	1¾
Average carting-hours per set	1¼	1¼	1¼	1¼	1¼
Cost of carting* @ 80c. per hour	$1.400	$1.400	$1.400	$1.400	$1.400
Cost of labor @ 60c. per hour	1.050	1.050	1.050	1.050	1.050
Cost of tools @ 2% of labor	.021	.021	.021	.021	.021
Total cost of labor	$2.471	$2.471	$2.471	$2.471	$2.471
Total cost of setting	$4.595	$4.698	$4.801	$5.910	$7.528

*Does not include driver. Vehicle assumed as a service automobile. Driver to be the mechanic. Where vehicle is horse-drawn, a unit cost of 30c. per hr. per horse may be substituted.

Grouting Wells in Rock Formation Effective and Simple

Water Protected from Contamination, Head Saved, Casing Protected—General Principles Stated—Examples and Cost

By W. G. Kirchoffer
Hydraulic and Sanitary Engineer, Madison, Wis.

GROUTING wells with cement has given such satisfactory results in the experience of the author on water-works construction and improvements that he ventures to submit some notes on several wells lined under his direction. First, the principal reasons for lining and some general remarks on practice will be given.

The wells discussed here are those that are drilled in and receive their water from a rock formation, and may be either deep or shallow. The reasons for grouting wells in the manner hereafter described are: (1) To save the head of flowing wells by preventing leakage into nonwater-bearing strata or through openings in the casing made by rust; (2) to protect the casing of either non-flowing or flowing wells from decay by substituting a cement mortar casing; (3) to prevent the water from becoming polluted by seepage from a source of contamination near the surface which perhaps is the most important of all and warrants the extra expense incurred. The additional cost may be partly offset by using a poorer quality of casing than would be safe without grouting, since the cement wall, properly put in, will last as long as the rock itself.

This process can be used for either new or old wells. If the old well is small in diameter and the surface of the rock or other noncaving formation is near the surface, the well can be reamed to a size sufficient to allow for the grout, or the size of the well may be reduced by inserting a smaller casing, properly packed at the bottom, to provide a form for the cement mortar.

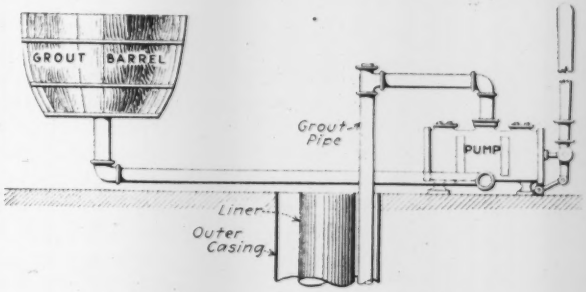
Grouting a New Well

In the case where the grouting is to be done on a new well that portion of the well that must be grouted is drilled to a large diameter, say 12 to 20 in., and to a depth sufficient to prevent leakage, seepage, etc. The depth to be grouted is usually predetermined by a knowledge of the strata and should preferably extend to or near the top of the water-bearing formation from which it is desired to obtain the water. An outside casing must be used in materials which will not stand long enough to permit of completion of the work.

The hole at the bottom of the grout should be made smaller, to a size just large enough to receive the "liner," which should be seated firmly in the rock to a depth of at least 2 ft. The liner can be made of any grade of metal sufficiently strong to withstand handling and prevent collapse. The top of both the outside and inside casings should reach the surface of the ground or to the point where the water is to be taken off. In the case of flowing wells, the liner may be used as the discharge or suction pipe if pumping is done, and directly connected to the pump or horizontal pipe. The space between the two casings should be at least 2 in. but more is desirable.

The grouting apparatus consists of a line of 1¼-in. pipe sufficient to reach within 10 ft. of the bottom of the space to be grouted, a hand or tank pump and a half barrel or watertight box of about the same size. The 1¼-in. pipe is hung between the liner and the outside of the well, so connected that it can be readily raised as the filling progresses. The grout is made of cement of such a consistency that it will pour readily. No sand is added while the pump is in use.

By having the dosing box or barrel above the pump the suction lift is eliminated and for that reason the grout flows much more readily. The water in the well should not be disturbed during grouting, as any difference in pressure might cause the grout to flow out of the annular space between the casings into the well. Tests for this leakage should be made by means of a small bucket which can be made of ¾-in. pipe, 6 in. long, let down in the well opposite the end of the liner. If cement is getting into the well, the water will have a milky appearance when brought to the surface.



THE GROUTING APPARATUS IS SIMPLE

When the grouting has reached a point near enough the surface to cover all rock crevices, one-third sand may be added to the cement and the mixture poured into the pipe in place of pumping it.

At Whitewater, Wis., the water-works plant has two deep wells, one 976 ft. and another 540 ft. deep, also two shallow wells. The 976-ft. well was drilled many years ago. When completed it had a head of 19 ft. above the ground level, and flowed 218 gal. per minute into a reservoir 110 ft. in diameter. The flow gradually decreased until it, with the two shallow wells, flowed only 1 in. in depth into the reservoir in 12 hours. The 540-ft. well was located close to Whitewater Creek, which receives the drainage from the city. The rock formation came near the surface at this point and was very badly shattered.

Plans for Reaming and Grouting Two Wells

After the sewerage system was constructed and before the disposal plant was completed, this well became contaminated to a marked degree. The surface of the St. Peter's sandstone from which a portion of the flow was obtained was encountered at a depth of about 154 ft. Plans and specifications were drawn for the reaming and grouting of these two wells to a depth of 156 ft. The outside casing in the surface materials was 16-in. O.D. casing and the hole in rock was 15 in. in diameter. The liner used was 8 in. inside diameter. The holes below a depth of 156 ft. were reamed to 8 inches.

When the work on the 976-ft. well was completed, it was again connected to the reservoir and the combined

flow of it and the two small wells was found to be 6 in. in depth in 12 hours in place of 1 in. before grouting; an increase of 500 per cent.

Well No. 2 was not connected to the reservoir, so no measurements were made, but contamination ceased. This well was really a new one, as the rock in the old well was so badly shattered and the hole so crooked that it was not reamed like well No. 1. This will be reduced from 8 to 4 in. in diameter and grouted like the others.

To prevent the grout from passing into the drill hole below the 4-in. pipe in No. 2 well, a rubber bag attached to a line of ¼-in. pipe was inserted to a depth of a few feet below the end of the 4-in. pipe. Air will be pumped into the ¼-in. pipe until the bag is inflated so that it presses firmly against the wall of the drill hole, which is very irregular. A small quantity of sand will be poured into the 4-in. pipe so as to be sure to seal the opening and cover the rubber bag before the grout is placed. After the grout has set, the air will be released and the pipe and bag withdrawn.

The work on the two wells to a depth of 156 ft. was let for $2350. The reaming below that depth was $3.50 per foot. The greater part of the cost of the work was, of course, in the reaming to a diameter of 15 in. and the casings. The process of grouting after the equipment is on hand is simple and comparatively inexpensive. The work on Well No. 1 was performed in two days by three men and required 27 bbl. of cement.

At Mineral Point two wells about 150 ft. deep were supplying the city, but became contaminated by surface water from the hills nearby. A new well of the same diameter as those at Whitewater was put down to a depth of 150 ft., with grouting to a depth of 64 ft. This well cost $710. The detailed prices were: In surface formations requiring 8-in. and 15-in. casings with grouting, $10 per foot; in rock requiring only 8-in. casing and grouting, $7 per foot; 8-in. hole in rock, no casing or grouting, $3 per foot.

A comparison of the bids on work of this kind with work involving only one casing follows: At Sparta, Wis., for drilling and casing a 16-in. O.D. hole to depth of 117 ft., with 10-in. liner and grouting to a depth of 190 ft., $1850 was the lowest bid. For the same hole 10 in. in diameter, cased to 117 ft., without grouting, the lowest bid was $899. The total depth was 277 ft. and in either case the bid for work below a depth of 190 ft. was $3.50 per foot.

At Hartford, Wis., the lowest bid was: 130 ft. cased with 16-in. O.D. casing, 330 ft. 10-in. casing and grouting to a depth of 330 ft., for the lump sum of $3180; 300 ft. 10-in. hole in rock at $5, $1500; total, $4680.

Making a Stream Build Its Own Check Dams

Floods Deposit Debris and Sediment in Porous-Walled Compartments Built Across and Up and Down Stream

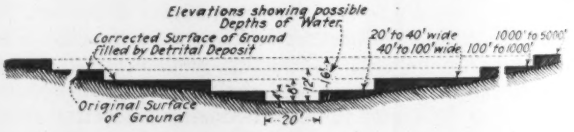
By Albert Marple
Tropico, Cal.

A SCHEME for building up check dams to prevent the erosion of stream banks with the detritus carried by flood waters has been applied in southern California. The plan, it is claimed, can be executed at far less cost than that of the ordinary check dams designed to accomplish the same purpose. The plan involves building, during the low-water season, a series of porous obstructions in the channel of the stream. These can be made of woven wire fastened firmly to posts, or of any other form of construction which will permit the water to flow through while retaining the débris. The point of primary importance to be observed in the construction is that the top of each successive obstruction or dam must be at about the same level as the bottom of the one next above.

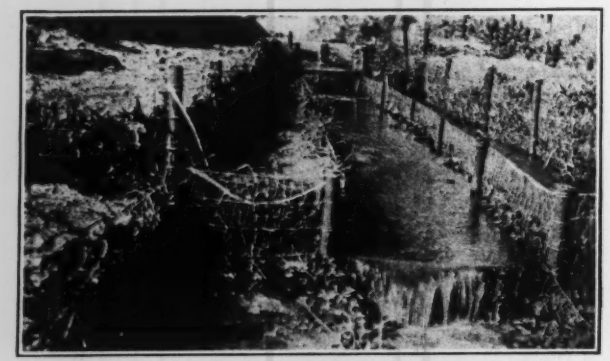
The theory is that the floating débris, sand, boulders and all matter carried along by the water strike the porous dam and partially clog it, thus retarding the flow and "backing up" the water in a pond behind the obstruction.

The detritus is deposited in this pond and the floating material is checked by the porous dam, increasing the storage capacity for detritus that will sink. The heavier material does not get as far as the dam itself until the pond or basin above has been filled to the level of the top of the dam. The dams are anchored upstream and as the pond fills the weight adds to the stability of the structure. An important feature claimed for this form of construction is that once the basins begin to fill it is impossible for the stream bed to shift.

When the first or upper basin has been filled, débris naturally begins to catch on the edge of the next dam below, and the process is repeated as far as the system has been built. The system may be built for the entire length of a stream or only at points where pro-


Elevations showing possible Depths of Water
Corrected Surface of Ground filled by Detrital Deposit
20' to 40' wide
40' to 100' wide
100' to 1000'
1000' to 5000'
Original Surface of Ground
20'

TYPICAL CROSS-SECTION PROTECTION WORK COMPLETED



POROUS CHECK DAMS PARTIALLY FILLED WITH DEBRIS

tection is necessary. The height of each successive structure, as the work is carried upstream, is increased enough to secure the desired effect. If the stream bed is very steep it may be that the lower edges of the upper "dams" will be suspended 6 to 10 ft. in the air. In such cases, of course, these upper dams would not come into service until those below had served the purpose.

By subdividing the space behind the dams into secondary porous compartments, with two sides across and two sides parallel to the stream bed, the cross-section to which the stream will build can be controlled to a nicety, the center being kept lower than the sides. After the basins are filled, the stream bed is "stepped up" from center to side just as the series of dams are extended upstream. The effect of this gradation of the banks is to keep the higher velocity at the center and comparatively quiet water at the sides.

The illustration shows such a protection work that was partially built up in Laurel Cañon Creek, near Los Angeles.

On this work a total of about a mile of protection has been built. Last winter an unusually heavy run-off occurred from a district tributary to Laurel Cañon that had been burned over. Water came in greater volume than ever before known and carried great quantities of sand and débris. When the flood subsided the entire check dam system was intact and about one hundred of the parallel secondary compartments were filled level with the tops of their protecting dams. The grade of the stream bed varied from 15 to 3½%. On the 10% grade the stream more than filled a bridge culvert 12 ft. wide and 4 ft. deep. The protected channel averaged about 25 ft. in width, and the center course varied from 8 to 10 ft. in height. The cost of installing the system including side lines, wings and all incidental work, averaged about $2 per lineal foot.

In an installation in a nearby cañon the width of the channel averaged 35 ft. and the grade was arbitrarily predetermined at 25%. The total installation extended for a length of about 150 ft. and had a center channel 10 ft. wide. The purpose of this installation was to prevent the erosion occurring as a result of this drop of 25 ft. This installation was also subjected to a severe run-off from a burned-over area. In both cañons so much sand was brought down that at times the entire structure was completely concealed, and was exposed later, it is stated, only by the continued action of the water.

The system described in the foregoing has been developed and installed by Alvaro W. Pratt, Hollywood, Cal.

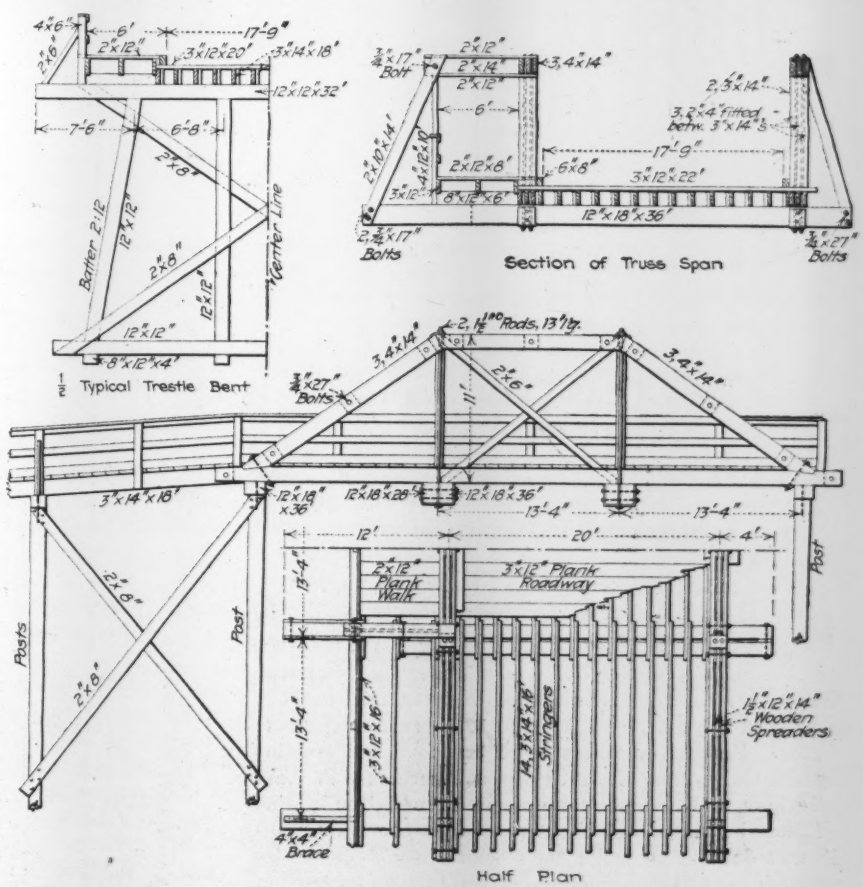
Plank Trusses Carry Streets Over Depressed Tracks

IN CONNECTION with the lowering of the tracks of the Oregon-Washington Ry. to eliminate grade crossings at Portland, Ore., described in *Engineering News-Record* of June 6, p. 1097, three temporary timber bridges were built to accommodate street traffic.

Truss spans of 40 ft. in two of the bridges carry the streets across the tracks, the remainder of each structure being a trestle with framed bents and spans of 16 ft. Each of these bridges has a roadway 17 ft. 9 in. wide and a 6-ft. sidewalk, and is designed for a live load of 200 lb. per square foot. The trestle approaches have grades of 6 to 8 per cent.

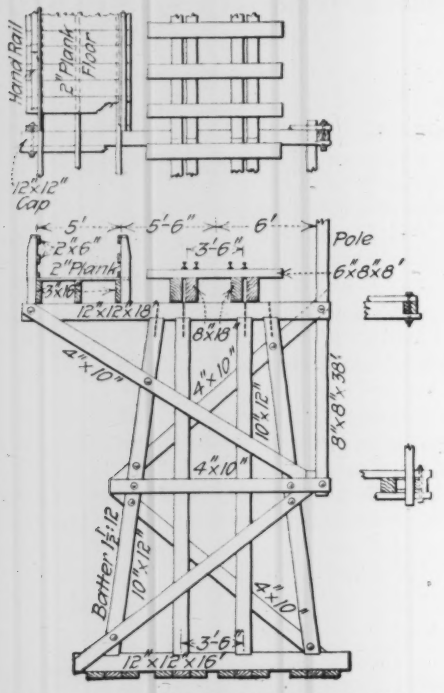
The trusses are built up of planks, as shown in one of the accompanying drawings. They are spaced 20 ft. on centers, and carry the 6-ft. sidewalk outside of one truss by means of extended floor-beams at the panel points. This necessitates a rather unusual arrangement of the bracing on the outside of this truss.

The third structure is a framed-bent trestle throughcut, with spans of 15 to 20 ft. It has no roadway, but



PLANK TRUSS SPAN IN TRESTLE CARRIERS STREET OVER TRACKS

carries only a single-track street-car line of 42-in. gage, and a 5-ft. sidewalk. The construction is shown in the drawings. This trestle is 700 ft. long and is built partly on a curve, so as to pass around the site of the permanent bridge. It has approach grades of



TEMPORARY TRESTLE PROVIDES SUPPORT FOR STREET-CAR LINE AND SIDEWALK

7%, these being reduced to 3.5% for a short distance on each side of the level 22-ft. span over the tracks.

Designs for these structures were included in the engineering plans prepared by the city for the grade separation. This work is under the supervision of O. Laurgaard, city engineer. The Pearson Construction Co., Seattle, has the contract.

Lake Beach Sand Has High Load-Sustaining Value

Some Tests Made at the Southern End of Lake Michigan Show a Maximum of Five Tons per Square Foot Is Permissible

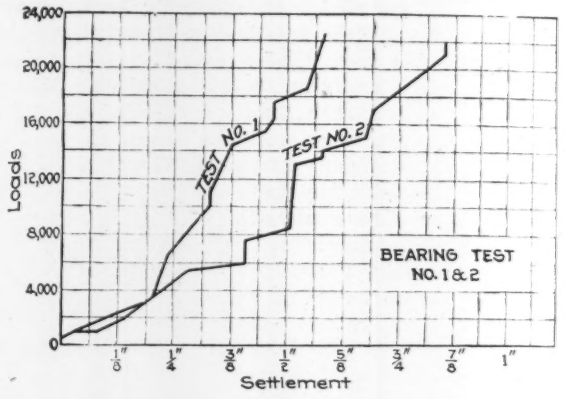
BY W. S. THOMAS
Assistant Engineer, Gary Tube Co., Lorain, Ohio

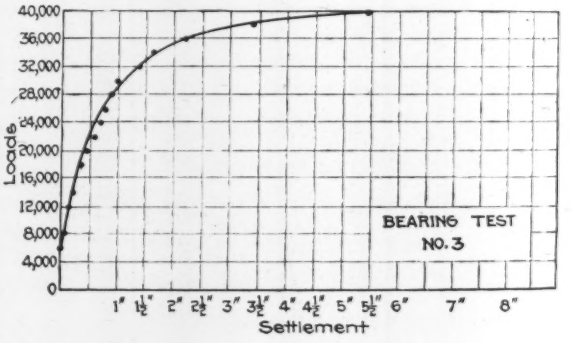
BUT little data has been published that shows the permissible loading on the fine sand of which the beaches of the Great Lakes are generally composed. When very heavy structures are to be erected on such a soil, tests generally are made to determine the safe figure. Certain buildings were proposed for erection by the Gary Tube Co. near the southern end of Lake Michigan, and since the contemplated foundation loading of these buildings was about three tons per square foot it was decided to make tests which would determine whether the soil conditions warranted such an imposition.

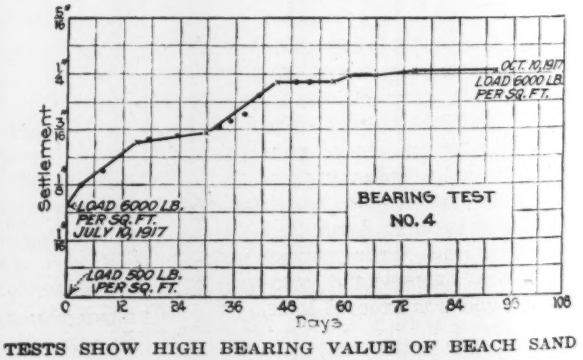
The soil at this point is composed entirely of a fine sand. Tests were made under these conditions at points not more than 2000 ft. from the shore. A loading platform, as is shown in the illustration, was constructed and the test location was well cleared of all grass and weeds. The bearing timbers were placed directly on top of this cleared surface, except that in the second test, holes a foot deep with sloping sides were due to receive the timbers.

As first planned, tests 1 and 2 were to be loaded to 10,000 lb. per square foot in increments of 500 lb. per square foot applied at intervals of 48 hours. This schedule was adhered to as far as possible, but when this load was reached and no decided settlement noticed, it was decided to continue the loading. As a result, a final loading of 22,000 lb. per square foot was reached without attaining any marked settlement. At this point the capacity of the platform used had been reached.

The bearing point elevation of the first test was 18 ft. above normal lake level. In the second test the bearing elevation was 3.5 ft. above normal lake level, and since water was reached at +4 ft., the bearing point in this test was 6 in. below the ground water






Settlement
OCT. 10, 1917 LOAD 6000 LB. PER SQ. FT.
LOAD 6000 LB. PER SQ. FT. JULY 10, 1917
LOAD 500 LB. PER SQ. FT.
BEARING TEST NO. 4
0 12 24 36 48 60 72 84 96 108
Days

TESTS SHOW HIGH BEARING VALUE OF BEACH SAND

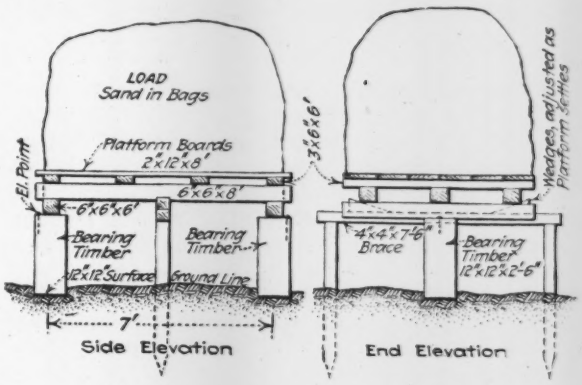
level. This test showed a greater settlement than the first experiment—due no doubt to this fact.

The first test having been stopped due to a lack of strength in the loading platform, this was strengthened to a point where it was thought sufficient to carry a load which would produce decided failure. The loading in this test was composed of large eye-bolts weighing from 33 lb. to 61 lb. apiece, and was placed on the platform in increments of 2000 lb. per square foot every 24 hours. No settlement was recorded until a load of 6500 lb. per square foot had been reached. This is probably due to the fact that the platform being heavier, the sand was compacted to a slight extent during the period of construction.

If the curve showing settlement of test No. 3 is moved over until its settlement at a loading of 65 lb. coincides with a similar loading of test No. 1, it will be found that this curve falls between the curves of tests 1 and 2. This would add about ¼ in. to the total settlement of this last test. A final loading of 40,000 lb. per square foot was recorded before failure occurred. One bearing timber settled to such an extent that the platform could not be used for further loading.

Based on the results of test No. 3 and using a factor of safety of 4, it would seem that five tons per square foot could be used as a maximum loading with perfect safety.

Test No. 4 was loaded to 6000 lb. per square foot at the start and the settlement noted from time to time. The load in this case corresponds closely to the contemplated foundation loadings. To a recent date the settlement amounted to $\frac{5}{32}$ of an inch, probably due in part to the displacement of the sand caused by the vibration from driving piles—since no protection was given to the bearing point to guard against disturbance of this sort or from the weather.



TEST PLATFORM CARRIED 22,000 POUNDS

The tests were conducted by the writer under the supervision of W. G. Bowman, chief field engineer of the Gary Tube Company.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Engineering Council's War Committee Wants Inventors

Members of the ten national technical societies represented on the war committee of the Engineering Council have received the Government Bulletin No. 2 on "The Enemy Submarine." They are asked in a circular letter to use their inventive talent and technical training in the study of the various problems which arise in the preparation for and prosecution of the war. The war committe was organized to make possible the utilization of the patriotism and original thought of the members who could not go to Washington with their ideas. "The greatest care will be taken," states D. W. Brunton, chairman, "to discover and utilize everything of value that may inhere in suggestions and inventions submitted. Not only will they receive studious examination but, when necessary, trials and experiments will be conducted. All inventions which have successfully passed the necessary examinations and tests are turned over to the particular departments of the army and navy service where they may be most profitably utilized."

In the bulletin, which was compiled by the Naval Consulting Board and the war committee to supersede Bulletin 1 on "The Submarine and Kindred Problems," are indicated more fully the requirements for war inventions, in order to show the limitations outside of which creative efforts may not be expected to produce results of value, and to assist the student in avoiding the duplication of previous accomplishment.

Engineers Study Compensation

Following the presentation of the article by W. A. Stinchcomb on "Engineering Salaries Adjusted to Cost of Living," in *Engineering News-Record* of Aug. 1, p. 238, the Young Men's Committee of the Western Society of Engineers, which meets regularly every week to discuss current engineering topics, society affairs and policies, learned that the salaries of five of those present were from 0 to 33% higher than on Jan. 1, 1917, the average increase being 20%. According to Mr. Stinchcomb's commodity tables they should have been increased 20%. Of the ten men present only five were able to segregate their living expenses into the classes noted in Mr. Stinchcomb's article. The average increase of the ten was 19%, ranging from 0 to 60%. Savings, which were considered the criterion of whether a proper compensation was being obtained, varied from 9 to 30% and averaged 18%.

Salaries of all had been increased except for a university professor and for two men in the employ of the City of Chicago, where no readjustments have been made in twenty years. The latter have been asking for increases varying from 22 to 33%, and it was with a view to getting at the reasonableness of the requests of the city employees that the committee went into the matter so thoroughly. Previous opinions to the effect that these men were properly compensated were speedily revised after an evening of intensive investigation and individual economic comparisons.

Incentive for further study was found in the dis-

closure of the rapid exodus of engineers from the city employ, because of the lack of recognition of advancing salary scales outside. One department has only 20% of its former force left. Those who remain are confronted with a staggering amount of work. Some departments are filling engineering positions with 60-day political nontechnical appointees.

While the young men's committee cannot commit the society to any expression of opinion, its own opinion is that the efficiency of the engineering work of the city is being lowered materially, that the citizens will be poorly served, and that the engineering profession will suffer prestige. Therefore, any effort to raise the pay of the city's engineers is judged by it a proper sphere of society activity.

Chicago Engineers Getting Together

Three more technical societies in Chicago have joined the war committee, making 19 in all. Military activities are being coördinated fast and the first of a series of meetings for members was held July 30. S. J. Duncan-Clark, war analyst of the Chicago *Evening Post*, spoke in the rooms of the Western Society of Engineers on "The Latest Moves on the War Fronts." It is planned to have noted war analysts describe various phases of the situation on the fighting front as they develop.

The committee has a paid secretary and is helping to place men in all technical branches of the Government. It is coöperating with the recently established engineers' division of the United States Employment Service and is sending out a brief questionnaire asking for a statement of qualifications and availability for war work.

Among many engineers there is talk of further cooperation and affiliation of general society activities. The progress made by the Cleveland Engineering Society in this line with the American Association of Engineers in reducing combined dues is being looked into.

Urges Engineers to Get into Politics

Under a July date the Illinois Society of Engineers has issued a one-page bulletin calling on engineers to bear their part as citizens and get into politics because of the obvious necessity of having the nation's affairs at this time in the hands of men selected only for their loyalty, ability, public spirit and strength of character, rather than for mere partisan or political reasons.

Continuing in this vein, the admonition to action in this time of carrying on a great war against a powerful and unscrupulous enemy, the bulletin states that men with any taint of "yellow" who seek office should be turned down decisively. The nation needs honest and true MEN as its representatives in the Government of the United States. The same reasoning is applied to the serious problems of preparing for the carrying on of commerce and industry after the war.

"Every member is requested to consider his own personal responsibility in the support of his country and of its principles of freedom and democracy," the bulletin states. "Act upon this principle at once in helping to select the right men, and at the primaries in voting for them. Our country must be our first consideration."

The Illinois Society of Engineers is in effective coöperation with 18 other technical societies of Chicago in war work and is a contributing member of the Citizens' Unit, a civil organization backing the 108th Engineers, formerly of the Illinois National Guard, by looking after the welfare and interests of the men and their families.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Equal Payments to Liquidate a Debt With Interest

Sir—Referring to my article entitled, "Equal Payments to Liquidate a Debt with Interest," appearing in *Engineering News-Record* of May 2, p. 871, and to criticisms by L. B. Merriam and Julian Hinds in your issue of July 18, p. 143:

The problem for which solution was offered was a purely practical problem which arose in the ordinary conduct of business between the executive heads of two corporations, one of which is the largest of its kind in the world. The only unusual feature of the problem was the stipulation that all payments should be equal, and the solution presented in my article was accepted after considerable correspondence and argument. The original proposal of the creditor corporation was that given in the last paragraph of my article.

So far as my experience and observation go, it is customary in the ordinary transaction of business to cover short-term debits by notes, each note cancelling a certain principal, and bearing interest thereon from the date of the note to its maturity. This is correct in theory and in practice, the idea being that the use of another's money involves an indebtedness for such use for the period during which the money is used, and that the obligation ceases coincidentally with the use. I believe this to be quite general practice, and I know it to be not unusual.

Mr. Merriam's criticism appears to be that in my solution the interest was not kept paid up to the dates of the several installments. The answer is that in the actual transaction the common use of notes was made.

Mr. Hinds' criticism is seemingly that a sinking fund was not provided for retiring the entire obligation at the end of the 29th period by a lump-sum payment. Mr. Hinds' method would be perfectly justifiable, but would have to be made the subject of a special agreement, and is not, I believe, in conformity with the usual business practice. It is a method which is frequently used by engineers and others in figuring relative economies of different schemes and in providing for amortization of long-term debts by periodical contributions to the sinking fund.

It does seem somewhat elementary to conduct a discussion relative to computing interest on a comparatively simple obligation, but, judging from the several methods which have been advanced both to me per-

sonally by letter and through your pages, there is not a well established and understood practice in handling this simple subject.

I cannot agree with Mr. Hinds' conclusion that "it is possible, of course, to agree to some arrangement, that suggested by Mr. Shepard, for example, which will give a result intermediate between simple and compound interest, but the logic or necessity of such an arrangement is not apparent." I am confident that a little investigation will show that many, if not most, matters of this kind are arranged by notes, each note standing alone so far as interest and capital are concerned, but the total capital payments embraced by the several notes equalling the total of the original obligation. This is the simplest and most logical kind of simple interest.

R. B. SHEPARD, JR.,
Office Engineer, Valuation Department, Atlantic Coast Line Railroad.
Wilmington, N. C.

Imhoff Tank Sludge Makes Raspberries and Lettuce Grow at Toronto

Sir—The experiment being carried out at Dallas, Tex., with Imhoff sludge, noted in *Engineering News-Record* of July 25, p. 164, is very interesting to me, as it parallels work which is being done in Toronto.

We have had considerable difficulty in obtaining a thoroughly digested sludge in our experimental Imhoff tank, but toward the end of last summer were getting a fairly good sludge. In spite of this, in the spring some of the office staff who were cultivating plots of ground used this sludge on their potatoes and corn, and although no quantitative results were collected, the size of the potatoes and healthy deep green color of the corn was very marked in comparison with that which had not been fertilized. The sludge was merely spread on the ground and then dug in, after the ploughing was finished. The soil is a clay loam and had not been cultivated for some six or seven years.

In consequence of this, I arranged with a market gardener about 14 miles from the disposal plant to take some of the sludge from the drying bed this spring and use it as he would his ordinary manure. He hauled altogether some 10 tons, containing approximately 60% water, and used most of it on two acres of his raspberry bushes. The remainder he used on small patches of ground in his kitchen garden. Unfortunately, the benefit to his bushes will not be definitely known until next year, except that a comparison of the new canes which will bear next year with those bearing this year is as the thickness of one's little finger to one's thumb. The new growth in 14 weeks is half as high again as in the unfertilized bushes. The color of the leaves on the fertilized bushes is a dark, rich green while on those not fertilized it is a light, yellowish green. The soil is a very light, sandy loam; in fact, on top of one mound is a blow sand, and it is in this place that the improvement is most noticeable.

The gardener in applying the sludge spread it on the surface of the ground and scuffled it in, and is very much pleased with the results he has obtained so far as it keeps the land moist and friable. He states further that with common manure he has a continual fight with a great variety of weeds, while with the Imhoff sludge there are only tomato plants to contend with and these are easily killed. His only complaint is concerning the cost of delivering the sludge to his farm.

It is unfortunate that the city itself cannot experiment, but at the present time all the land available around the works has been taken over by the Rotary Club and given out in small holdings to the residents

IMHOFF TANK SLUDGE MAKES LETTUCE GROW

of the neighborhood for garden truck, and they are only amateurs.

I am inclosing a photograph of two heads of lettuce grown within 10 ft. of each other, one of which was sludge fertilized.

I hope to continue the experiments, not only with the Imhoff sludge, but also with the old sludge in the lagoons, which are really shallow separate digestion tanks.

This work is all carried on under R. C. Harris, commissioner of works, W. R. Worthington, assistant engineer in charge of sewers, with myself as general superintendent of the plant.

I. H. NEVITT,
Superintendent, Main Sewage Disposal Works.
Toronto, Ont.

Effect of Frost Action on Pavements

Sir—The explanation given in J. L. Harrison's article, in *Engineering News-Record* of Feb. 28, of the manner in which concrete pavements are injured by frost, seems to be borne out by observations made on an unusual case of heaving which occurred on a New York state highway in Chautauqua County.

The pavement, on the northern end of the Jamestown-Bemus Point road, was laid in 1916, but for some reason the construction of a small culvert and of the short section of pavement over it was delayed until October of the following year. On excavating for this culvert, soft black muck was found about 4 ft. below the surface, and several springs were encountered, some of them directly under the pavement.

To provide foundation for the culvert and drainage for the springs, a blanket of fine gravel and sand and an 18-in. layer of screened gravel were placed in the

bottom of the trench. Screened gravel was also used for backfilling the trench.

Because of the lateness of the season, it was necessary to build the pavement as soon as possible after the culvert was finished, and to eliminate danger from settlement of the backfill the portion of the culvert top under the pavement was brought to subgrade elevation with 1:3:6 concrete. Metal reinforcement was placed in the bottom of the pavement slab where it spanned the trench.

Metal reinforcement weighing 0.28 lb. per square foot was also placed 2 in. below the surface over the entire area of the new pavement. The adjoining old pavement was not reinforced.

The winter of 1917-18 was unusually severe in this neighborhood, but there was a period of fine weather in March with temperatures as high as 50° F. on Mar. 12 dropping to 10° F. on Mar. 16. On Mar. 17 what was apparently a serious settlement at the culvert was noted, but careful levels, taken at that time, indicated that there had been neither settlement nor heaving directly over the culvert, but that the pavement on both sides had been raised from 0.3 ft. to 0.4 ft. higher than the elevations shown by a survey made the previous autumn. This heaving seemed to be uniform, extending at least 1000 ft. in both directions from the culvert, but no breaks appeared in the profile except at the culvert.

Subsequent levels show that the pavement has gradually settled to nearly its original position. The elevations, taken in November, 1917, were recorded only to the nearest tenth, but they are sufficiently close to show that the frost had little if any effect on the position of the culvert. It would seem that the precautions taken to insure drainage at that point prevented heaving by affording a means of relief from the pressure which resulted from freezing.

No serious cracks, and very few of any kind, have developed during the course of the heaving and settlement, probably because the material composing the subgrade is uniform in character, and because the cross-section of the roadway is such that all surface drainage is promptly removed.

CHARLES T. FISHER,
Senior Assistant Engineer,
New York State Highway Department.
Jamestown, N. Y.

More About the Baltimore Imhoff Tanks

Sir—The article by Thomas D. Pitts entitled "The Truth about Imhoff Sewage Tanks at Baltimore," published in *Engineering News-Record*, July 11, is an interesting one. It is not the intention of the writer to attempt to discuss the operation of the circular Imhoff tanks at Baltimore, but it may not be amiss to say that those who are familiar with the operation of sewage settling tanks will not be at all surprised to learn that circular tanks with a radial downward and upward flow have not proved satisfactory in operation. It has always appeared to the writer that the principle of such operation is fundamentally wrong.

Mr. Pitts says: "I do not believe that the Imhoff tank will prove satisfactory for any plant which has to handle quantities of sewage approximating ours, especially where it is stale, as at Back River, but it may be both satisfactory and economical for smaller plants, with fresher sewage, if ample sludge room is provided." Will Mr. Pitts be kind enough to supply the data on which he bases this opinion? It is difficult to see wherein the volume of sewage to be handled is any factor in the question of treatment by Imhoff tanks—provided, of course, that the tanks are of sufficient capacity to handle the flow. And it would be interesting if Mr. Pitts would explain why Imhoff tanks will not handle stale sewage.

Mr. Pitts further says: "I should prefer a longitudinal-flow design in any event, and our experience is that the horizontal flow is less likely to lead to excessive sludge formation than the downward flow used in our tanks." It would be interesting if Mr. Pitts would explain just what he means by this statement and by the term "excessive sludge formation." The statement would seem to lead to the conclusion that less sludge would accumulate with a horizontal-flow tank than with a radial downward-and-upward flow tank of the type used at Baltimore.

And does Mr. Pitts mean to convey the idea that it is desirable, in order to prevent what he terms "excessive sludge formation," to have some of the suspended matter carried over in the effluent rather than to have it deposited in the tank? The writer has supposed, generally speaking, that one function of a sewage settling tank was to remove as much of the suspended matters as possible.

OPERATOR.

[To the foregoing letter Mr. Pitts replies as follows.—Editor.]

Sir:—My belief that the Imhoff tank will not prove satisfactory for large disposal plants such as that at Back River is due chiefly to the increased cost for maintenance and operation which has been shown by our experience. I am also of the opinion that the stale condition of the sewage, which always exists in such large plants (at Back River the sewage is distinctly septic), makes the operation of the tanks less satisfactory because the solid matter is to some extent broken up by the septic action, so that sedimentation is less complete, and also because the septic condition of the sewage apparently tends to increase the odors from the tanks. I am, unfortunately, unable to support my beliefs on these points by laboratory data, because for the past two years our technical staff at Back River consisted of a chemist-bacteriologist and one laboratory helper only, and under those conditions it was impossible to do anything more than the necessary routine work. I am, and have always been, of the opinion that our results could be improved if the city authorities would provide a sufficient technical staff for somewhat extended investigation work, but, lacking this, comparison of the observed results at Back River with stale sewage, with the results obtained in other plants with fresher sewage, has led me to form the opinion I have given.

As to "Operator's" last question, I am not surprised that he cannot understand my statement about excessive "sludge" formation. The reference should have been to "scum," not sludge. The layer of scum which formed on the surfaces of our tanks was so deep that it frequently extended below the bottoms of the baffles, so that it was necessary to put the tanks out of service until the scum could be sunk or skimmed off.

Philadelphia. THOMAS D. PITTS.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Prompt Reward Incites Effort

PROMPT reward for extra effort is the best incentive to continued high effort by workmen. A time-card system, which furnished each workman every night a credit slip for money earned during the day, was described in *Engineering News-Record* of Aug. 1, p. 244. On road construction visited a year or two ago, a somewhat similar procedure devised for a different purpose was observed. A bonus system of payment was being operated, and every morning as the men reported for work each was handed a slip giving him credit for the regular wage and for the bonus earned by him during the preceding day. The direction of the work was unique, perhaps, in no respect, except in the issue by the pay clerk of these daily credit slips for money earned. A potent psychological factor was, however, called into play by this action. Any reward that is deferred to a relatively far-distant pay day has little effect as a spur to increased effort on the average man. Either reward or punishment, if it is to be effective, must be promptly applied. With the system of credit slips mentioned immediate reward was possible, and the regular routine of the weekly payroll was not disturbed. The slip received by each man every morning was tangible evidence to him that extra money was his because of extra effort made by him the day before. It was an incentive to him to begin the new day's work determined to equal or excel his record of the day before.

C. S. H.

Other Articles In This Issue of Interest to Contractors

Roads in Base Section of American Forces Require Widening and Resurfacing Page 348

Build Walls and Roof Before Second Floor Page 354

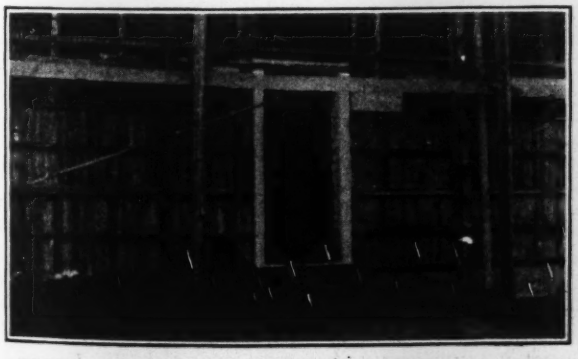
Framing Plans Simplify Fieldwork on Cincinnati High School Page 355

Rock Cribs Blanket River Bank in California Page 364

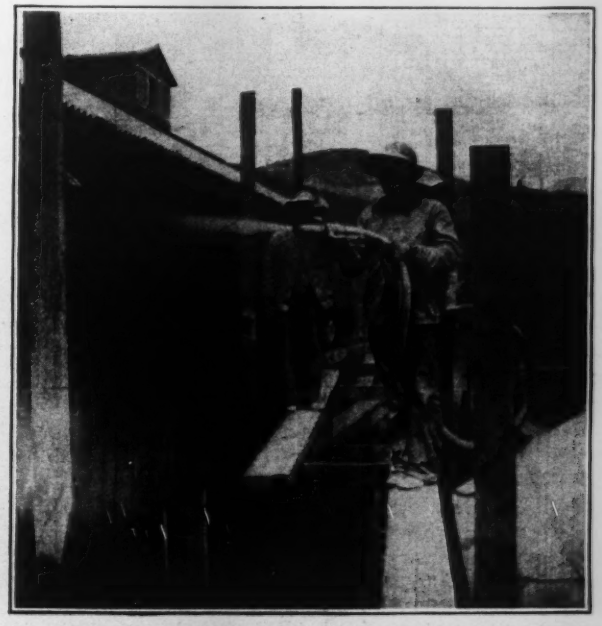
Cement Gun Used To Put Concrete Walls on Wood-Frame Mine Mill

NEW concrete walls to replace siding on three wood-frame mills of the Portland Gold Mining Co., at Victor, Col., were effectively put on last spring with the cement gun. The work was started by stripping the buildings to the wooden skeleton. To this skeleton was nailed triangular wire mesh in rolls 50 in. wide and 150 ft. long. After the wire had been stretched to the frame, unit forms were put up on the outside. The forms varied in size, the standard being 16 ft. long and 3 ft. wide, but all consisted of a top, bottom and middle wall of 2 x 4 in. pieces with vertically placed $\frac{3}{4}$ in. cedar lagging. The lower form was nailed to the framework; the succeeding ones were nailed at the bottom to the form immediately below and wired at the top to the studding. Concrete was then applied from the inside for a thickness of about $1\frac{1}{2}$ in. When the wall had been shot from the inside the forms were taken down and the concrete applied from the outside until a 2-in. thickness was secured. The surface was then given a stucco finish. For the gun 45 lb. air pressure was used, and the water carried its natural pressure of about 60 lb. The flow of air was about 175 cu.ft. per min. The 1:3½ mix was turned once before being thrown over a ⅜-in. screen. It was then shoveled into a hopper and drawn from there into the gun. Once applied, the concrete was wetted twice or three times on succeeding days. Before shooting against concrete already placed the wall was thoroughly washed with a hose.

Both swinging and stationary scaffolds were used.



FORMS WERE PLACED IN UNIT SECTIONS 3 FT. DEEP



SHOOTING CONCRETE WALL ON OLD WOOD FRAME

The highest stationary scaffold was 55 ft. and the swinging scaffold was used on the tallest building, 82 ft. in height.

The percentage of rebound varied with the local conditions and the nozzleman. Experiments showed that between 7% and 35% of the concrete fell as rebound. This was taken up and used again. The concrete adhered to the wall only when applied directly and at right angles. When shooting from the inside it was found impossible to get the material against the form behind a timber such as a brace. What concrete was forced between the timber and the form was merely rebound and could be disintegrated with a trowel.

The forms were taken down between 12 and 24 hr. after shooting. If they remained longer they were hard to remove.

A total wall area of 40,000 sq.ft. was concreted. The last building, containing about 12,000 sq.ft., was completed in three weeks. The average amount of wire placed in a day by three men on the scaffold and two on the ground was 900 sq.ft., the record for four men on the scaffold being 2,500 sq.ft. A daily average of 750 sq.ft. of concrete 2 in. thick was maintained throughout the work, using one gun.

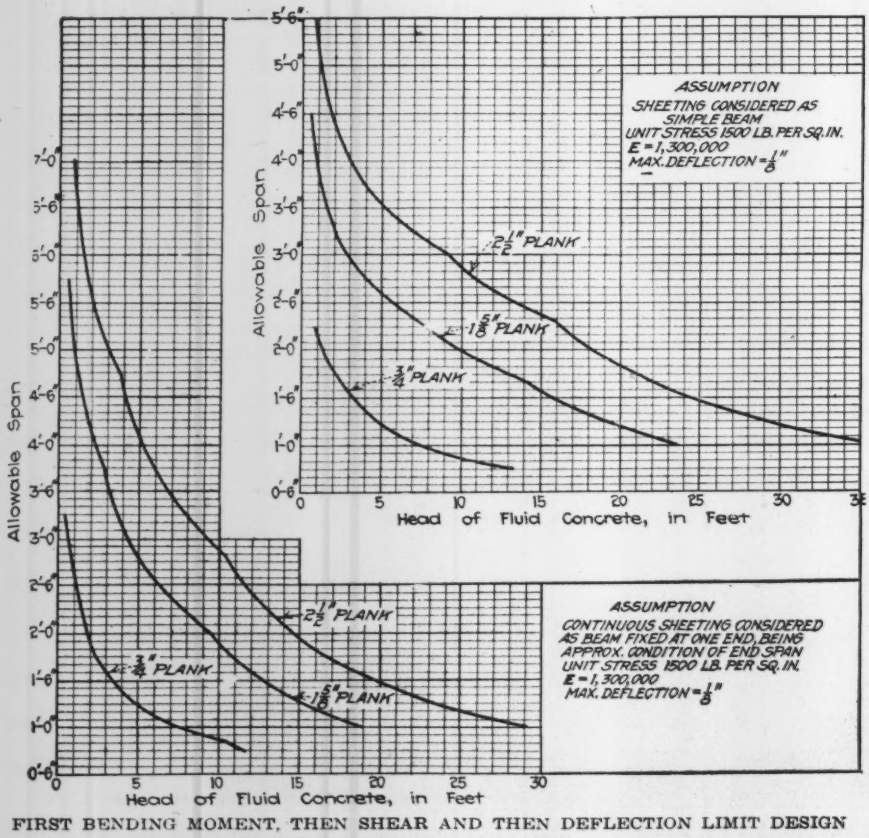
Show Size and Span of Sheeting at a Glance

BY S. M. COTTEN
Phoenix, Ariz.

TWO charts which make it easy to select at a glance the size of sheeting and the allowable span in designing concrete forms were developed by the writer in connection with the bridge work of the State Highway Department of Arizona. They are reproduced herewith.

One of the charts was calculated by assuming each piece of sheeting to act as a continuous beam, the unit stress being taken at 1500 lb. per sq.in. and the modulous of elasticity at 1,300,000, a maximum deflection of $\frac{1}{8}$ in. being allowed. The plank is considered as a beam fixed at one end, this being assumed to be the approximate condition of the end span. It will be noted that this chart allows somewhat longer spans for low heads, while the other chart, calculated on the same assumptions but for simply supported sheeting, indicates that sheeting under this condition of loading can support higher heads over short spans.

The individual curve for plank of each size is not uniform, the breaks occurring where a change takes place in the factor which controls the allowable span, the maximum deflection being the limiting condition in some cases, the bending moment in others, and the shear in still others.


ASSUMPTION
SHEETING CONSIDERED AS SIMPLE BEAM
UNIT STRESS 1500 LB. PER SQ. IN.
E = 1,300,000
MAX. DEFLECTION = 1/8"
Allowable Span
Head of Fluid Concrete, in Feet
2 1/2" PLANK
1 5/8" PLANK
3/4" PLANK
ASSUMPTION
CONTINUOUS SHEETING CONSIDERED AS BEAM FIXED AT ONE END, BEING APPROX. CONDITION OF END SPAN
UNIT STRESS 1500 LB. PER SQ. IN.
E = 1,300,000
MAX. DEFLECTION = 1/8"
Allowable Span
Head of Fluid Concrete, in Feet
2 1/2" PLANK
1 5/8" PLANK
3/4" PLANK

FIRST BENDING MOMENT, THEN SHEAR AND THEN DEFLECTION LIMIT DESIGN

Build Concrete Pier in Ice Sheet Twenty-five Feet Thick

A SOLID mass of ice 25 ft. thick covering rock had to be penetrated to gain a foundation for the south river pier of the Hudson Bay Ry. bridge over the Kettle Rapids of the Nelson River, only 100 miles from Hudson Bay. The site of the pier is on a rock island, under all ordinary conditions, but in winter ice jams raise the river level sometimes as much as 20 ft., and when the construction gang was ready to start work the water stood 10 ft. above the rock level. As the working season is short, no time could be lost, and the pier had to be built in the ice. To start work the ice was excavated, and in a little more than three weeks rock was reached. By this time the level of the water in the river had fallen a few feet, but it was still well above the rock level. Though the ice walls of the shaft appeared perfectly solid, water percolated through so that it stood at the same elevation as in the open river channel, some distance away. A timber caisson was built, shaped on the bottom to fit the irregularities of the rock surface, and was sunk within the well. All openings in the caisson walls were sealed by driving sheetpiling, scribed to the rock surface and driven so as to broom the ends. The entire rock surface inside the caisson was then picked with needle bars, to insure its being entirely clear of ice. As previous examination of the rock during low water had shown it to be sound, the foundation was now ready for concreting. Concrete made of heated materials

was deposited within the caisson by deep-water buckets, and the footing was completed within four days after the rock was first reached. No difficulties developed during the construction of the pier shaft.

The work was done by MacDonald Bros., for the Hudson Bay Ry., J. W. Porter, chief engineer.

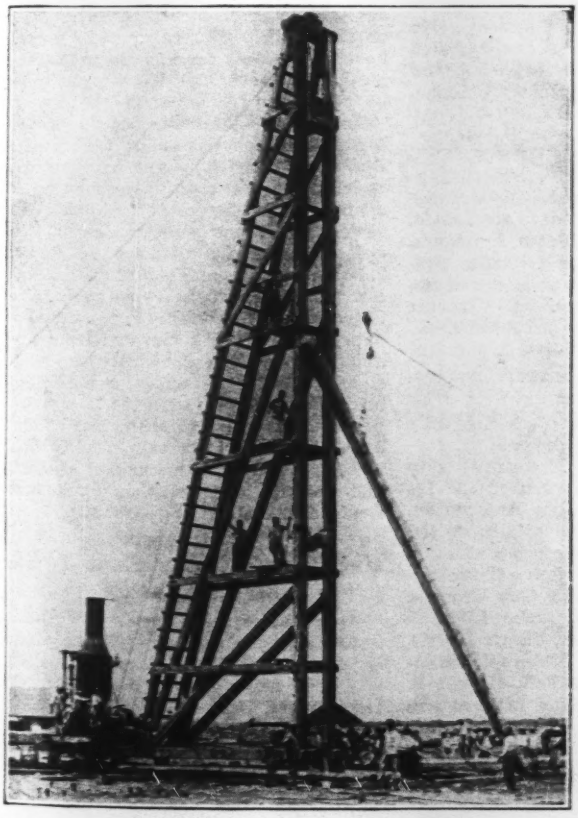
Cast Pickup Bars for Handling in Concrete Piles on Java Contract

By A. S. Buisman
Engineer, Holland Concrete Company of Weltevreden, Dutch East Indies

STEEL rods stuck through the form and extending beyond the sides of the finished concrete pile at the points for attaching the double lifting tackle were found very convenient by the Holland Concrete Co., of Java, Dutch East Indies, in recent work. Two inches or more projected on each side of the pile, serving to engage double lifting hooks. Since the pickup points were properly placed beforehand, this made it simple to raise the piles and put them in the leads, and at the same time reduced the lifting stresses to a definite basis and made accurate design possible.

It was required that the piles be placed in a definite position, and the expedient of putting the bars a little off center made it easy to raise them in the proper hoisting position. Fastening and detaching the hooks took a minimum of time, as it was simply necessary to slip them under the ends of the pickup bars. All damage to the piles from using chain or rope slings was entirely avoided.

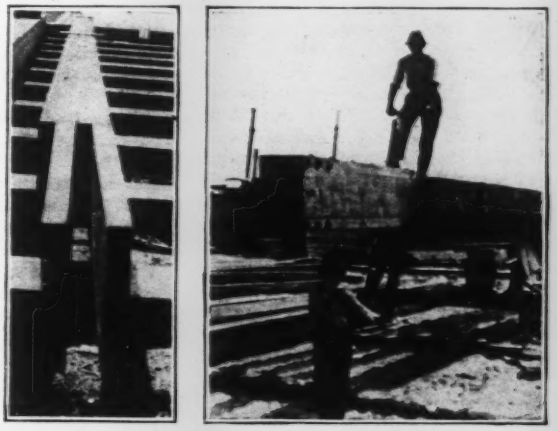
The piles with which this was done are not exposed to the action of sea-water; but, had they been, the same method would have been employed, using hardwood pins instead of steel bars.



DOUBLE LIFTING HOOKS ENGAGE BARS CAST IN PILES

Triple Scarf Used in Dry Dock Timbering

IN THE side frames of a number of wooden floating dry docks now under construction, W. T. Donnelly, consulting engineer of New York City, has introduced a triple scarf joint, economically cut in a special miter box, instead of the standard single scarf commonly used. The joint and the method of sawing it are shown herewith. As usually made in a 14-in. stick, the single scarf is about 6 ft. long, with four or five bolts and a 2-in. normal cut on each side. In place of this the triple scarf reduces the slope of the oblique cut so as to permit of two normal 2-in. cuts on each end of the joint, and reduces the length to about 4 ft. Increased efficiency of the joint is claimed.



MITER BOX USED TO SAW SCARF JOINT SHOWN IN VIEW AT LEFT

In making the triple lap the miter box is used as a saw guide, as shown in the view, and the joint is readily chiseled out between the cuts.

Toll Roads Disappearing in Pennsylvania

With the conclusion of negotiations between State Highway Commissioner J. Denny O'Neil and officials of the Lancaster & Susquehanna Turnpike Co., the Lincoln Highway in Pennsylvania was freed from its last toll section. Since Commissioner O'Neil took office he has succeeded in freeing approximately 200 miles of state highway routes from the toll system. This has been accomplished through the use of funds provided by the 1917 session of the state legislature, which set aside $500,000 for the purpose of buying up these franchises. There still remain 308 miles of toll roads in the state, of which 185 miles are located on state highway routes. It is planned to eliminate these as fast as arrangements can be made with the counties and the turnpike companies. Under the present arrangements the counties are paying one-half the cost of elimination.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Boston Transit Commission Goes Out of Existence

24-Year Life Ends When All Extensions of Program for Rapid Transit Are Completed

After an existence of 24 years, the Boston Transit Commission ceased to exist on June 30 last.

In 1894 the commission of five was created to construct the Tremont St. subway. Its term of office was to be five years. Before the term had expired the legislature authorized the construction of the Washington St. tunnel and the East Boston tunnel, and afterward it authorized the construction of still other subways. The term of office of the commission has, therefore, been extended from time to time, and it expired by limitation June 30, at which time all the subways authorized had been completed. Some work left, including settlements for damages and other legal matters, and the construction of a transfer station between subway and surface cars at Massachusetts Ave., on the Boylston St. subway, are to be handled by the Mayor of Boston, the city treasurer and the commissioner of public works. The Boston Transportation Commission, however, consisting of the city treasurer, the commissioner of public works and one appointed member, has been created. Ex-Mayor Josiah Quincy, a former member of the Transit Commission, is the appointed member.

During its term of office the Transit Commission has expended about $38,500,000. The successive acts which have prolonged its existence have usually provided that the term of office of the members should be extended, so that the commission has been unbroken in membership, except by death or resignation. Prof. George F. Swain was a member of the commission throughout its existence, and Horace G. Allen served from 1896 on. Three of the members originally appointed since 1894 have died, and one resigned.

With the passing out of the commission an engineering staff composed of men with long experience in subway and other transportation matters, was broken up. Almost all of the men have secured other positions.

Federal Engineering Employment Service Busy

The new Division of Engineering of the United States Employment Service, opened a short time ago in Chicago under the direction of A. H. Krom, seems to be very busy. The record for the month of July shows that the division received 468 applications for help from employers, 1314 applications for help from workers, was able to forward 1063 applications and actually placed 483 men in positions. This branch of the Government Employment Service is intended to serve as a clearing house for the employment of Government engineers, although it may extend to private work in the future. It is urged by the division that engineers register, either through the local branch of the United States Employment Service or through the Division of Engineering at Chicago.

Joint Highway Meeting Postponed

The joint convention of the American Association of State Highway Officials and the Highway Industries Association, which was to have been held during the week beginning Oct. 5, as announced in *Engineering News-Record* of July 18, p. 149, has been postponed until the week of Dec. 2. It is stated that conditions which became known after the original date had been set made this action advisable.

The highway officials will hold closed meetings on Monday, Tuesday and Friday, while the joint meetings will be held on Wednesday and Thursday. No change has been made in the proposed place of meeting as far as known, and it is expected to take place in Chicago.

Let Contract for Nitrate Plant at Toledo

Contract for the construction of the Government nitrate plant at Toledo, Ohio, has been let to Bates & Rogers, of Chicago, by the Air Nitrates Corporation, the Government agent in the construction and operation. The cost is estimated at close to $10,000,000.

Concrete Ship Association Formed

At a meeting in New York City July 24 assembled for the purpose of furthering the interests of concrete ship construction there was formed the International Concrete Ship Association. For the time being the affairs of the association are to be conducted by a general committee composed of the following twelve members: Guy Vroman, H. F. Cuntz, Victor C. Coxhead, Frank Van Vleck, K. McLeod, R. C. Morris, E. H. Beckert, A. C. Holzapple, Maurice Deutsch, John C. Pell, Harold P. Brown and Albert Oliver. Offices will be at 7 E. 42d St., New York City, with H. F. Cuntz as secretary. Annual dues have been fixed at not to exceed $500 for corporations and at $25 for individual members.

More Money Needed for Free Bridge Approaches

$250,000 Estimated as Needed to Put St. Louis Bridge in Partial Use—$8,000,000 for Full Use

Expenditure of about $250,000 to permit even a partial use of the municipal (free) bridge across the Mississippi River at St. Louis will be necessary, states B. F. Bush, regional director of railroads for the Southwest district in a letter to the president of the St. Louis Chamber of Commerce. In addition to $16,000 for changes to permit connections with the tracks of the Merchants' Bridge Terminal Ry. without the use of objectionable reverse curves—an expenditure which Mr. Bush stated he would recommend that the Government issue authority to make—he enumerates $157,000 for double-track work and connections on the east side, $35,000 for a double-track connection with the terminal railway tracks near Eighth St., St. Louis, and $35,000 for an interlocking plant. These expenditures, however, would, the letter states, make possible only partial use of the bridge for freight trains, involving two objectionable back-up movements on the east side of the river for the greater part of the traffic. Something more would have to be spent for signals and interlocking if the bridge were to be used by passenger trains.

To permit extended use of the bridge for freight and passenger trains, Mr. Bush quoted the following figures from estimates made some time ago by a disinterested engineer: North and south connections with tracks of Illinois Transfer Co. at East St. Louis, $500,000; additional connections and interlocking plants between east side lines to permit routing trains to the easterly approach, $500,000; elevated structure and approach from vicinity of relay depot, East St. Louis, to municipal bridge, $3,000,000; south St. Louis approach at west end of Municipal bridge, $1,000,000. This makes a total of $5,000,000, but at the present cost of labor and material Mr. Bush thought the cost would be increased to $8,000,000.

Huge Gun-Relining Plant To Be Built in France

Approval of the plans for the building of an enormous gun-relining plant for the United States Army in France has been announced by the Ordnance Department, United States Army. This plant will reline the big field guns, which are put out of service after about 200 shots. The project calls for an expenditure of from $25,000,000 to $30,000,000, the machine tools alone

running well up toward $20,000,000. In addition to the tools and the buildings housing them, there will be a number of 240-ton cranes, a steam electric generating plant of approximately 5000 kw. capacity, and housing facilities for the workmen. Among the machines required is a planer 500 ft. long, the largest ever built. This has as a distinguishing feature a bed plate of reinforced concrete instead of the usual wrought iron.

Government May Take Over All Power Plants

To meet the power shortage throughout the country a bill has just been introduced in the House by Representative Sims, of Tennessee, which provides "that the President may construct or acquire power plants and transmission lines, and incidental property necessary for the production of material and commodities essential to the national defense." He is empowered either to take over privately-owned power plants or to advance funds from the appropriation to assist in their private operation. The measure specifies further that the power to construct or acquire any power plant, transmission lines or incidental property shall terminate at the end of the war, and that the power to operate and maintain the plants shall continue only for such time as the President shall deem necessary.

Compensation when the plants are taken over is to be fixed by the President. In the event of a dispute, 75% of the amount fixed by the President shall be paid, and the owner may sue for the remainder in dispute.

The bill carries an initial appropriation of $200,000,000 for acquiring power plants. A large portion of this, it is reported, would be used to build or acquire power plants at the mouths of coal mines.

Canadian Engineering Standards Committee Organized

The Canadian Engineering Standards Committee has been organized in Montreal with official representation from the government departments, the Canadian Manufacturers' Association and several important technical organizations. Its objects are to secure interchangeability of parts, to cheapen manufacture by the elimination of the waste occasioned by a multiplicity of designs for the same purpose, and to effect improvements in workmanship and design. It is expected to have the effect of harmonizing British and American practice.

The following officers were elected: Chairman, Sir John Kennedy; vice chairmen, P. H. Vaughan and Capt. R. J. Durley; honorary secretary-treasurer, Dr. John B. Porter; secretary, Frank S. Keith. The headquarters of the committee will be at the Engineering Institute Building, 176 Mansfield St., Montreal.

Publicity for War Department Purchases

Will Regularly Give Out Lists of Articles Purchased Under Various Bureaus

The General Staff of the War Department has prepared plans for obtaining publicity for lists of all articles purchased by any supply bureau, so that all manufacturers and the public generally may obtain full information regarding the needs of the department. Any manufacturer in the United States who wishes to manufacture Government supplies is invited to send in his name to the bureau purchasing that kind of supplies and state his position to furnish the goods.

It is announced that circular proposals will be sent to all persons on such mailing lists whenever the bureau need supplies. These will be invitations to submit bids. Full publicity will be given as to the opening of the bids and the awarding of contracts, except in cases where it may be decided that valuable information would be transmitted to the enemy. Determination as to the military value of such information will be decided by military censors and not by the officers or persons handling the supplies in the bureaus.

Any manufacturer interested in having his name on such lists should send in his application, accompanied by references from banks or reputable business concerns or from the chairman of the local regional manufacturers' organization associated with the War Industries Board. If his plant is deemed satisfactory as well as his references, his name will be placed on the mailing lists of the bureau which handles the supply in which he is interested, and he will thereafter receive the notices sent out by the War Department regarding the purchase of articles.

It is announced that, in conjunction with this service, desks are being established to afford information to manufacturers and their representatives as to the officers handling the articles purchased by the bureau, and to supply blanks for proposals. A central information office will be maintained at the office of the Director of Purchases and Supplies, General Staff, and bulletin boards will be erected on which will be posted all circular proposals.

Argentina in Market for Sulphuric Acid Plant

In various newspapers the following advertisement has recently appeared:

"Offers are invited for the construction of a plant for manufacturing sulphuric acid, in accordance with the conditions which may be consulted by interested parties, in the Consulate-General of the Argentine Republic in the City of New York, 17 Battery Place, Room 227, on working days from 10 till 4.

"Offers must be presented in the office of the Secretary of the Council of Public Works of the Nation, in the City of Buenos Aires, before 3:30 p. m. on Nov. 8 next, on which day and hour they will be opened in the presence of the interested parties who may wish to attend on that occasion."

Inquiry at the Consulate reveals the information that the Argentine Republic has a flat area of land and the wish for a sulphuric acid plant producing 25 tons per 24-hr. day. This comprises the specifications upon which bidding is to be based.

New Pacific Coast Shipyard Started

At Alameda, Calif., near the present plant of the Union Iron Works, the Bethlehem Shipbuilding Corporation has just started a shipyard which will rank among the largest in the United States. The formal opening of the works occurred Aug. 13, when the first pile was driven. The plant will contain ten slips and will cover more than a third of a square mile. It is intended to build there first a large cargo vessel for the United States Emergency Fleet Corporation. Monks & Johnson of Boston are the architects and engineers, and the Aberthaw Construction Co. is the contractor. It is announced that the new yard will be known as the Liberty Shipyard.

Duluth Engineers' Club Organized

The Duluth Engineers' Club was organized at a meeting held Aug. 5, at which a committee on organization, appointed last May at a joint meeting of Duluth engineers, submitted articles of incorporation, which were adopted with a few minor changes. Officers were elected as follows: President, W. G. Swart; first vice president, E. R. Lewis; second vice president, W. N. Ryerson; secretary, W. H. Woodbury; treasurer, W. H. Gallagher; members of board of directors, F. E. House, T. W. Hugo, W. F. Schwedes and F. E. Downing.

Two Bids for 72-Inch Steel Pipe at Jersey City

Two bids for 34,590 ft. of 72-in. riveted steel pipe to duplicate the portion of the Jersey City water-supply conduit from the Boonton reservoir to the Watchung tunnel were received on readvertisement Aug. 13. The Riter-Conley Co., Pittsburgh, bid $23.72 per lin. ft. on 34,125 ft. of pipe from ⅜-in. plate and $41.05 on 465 ft. from ½-in. plate, making a grand total of $828,533. The James McNeil & Bro. Co., Pittsburgh, bid $26.50 and $30.75, respectively, making a total of $918,611. M. I. Fagen is director of the Department of Streets and Improvements, Jersey City. Rejection of earlier bids from the same companies was noted in these columns Aug. 8, p. 293.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

PERSONAL NOTES

W. A. WELCH, chief engineer of the Palisades Interstate Park Commission of New York and New Jersey, was given a leave of absence by the commission in July to accept a captaincy in the timber department of the Air Service, which is carrying on the work of getting out spruce for airplane construction in Oregon and Washington. Mr. Welch was made chief engineer of a large mileage of logging railways in the Northwest and has recently been promoted to major.

ANSON BURLINGAME MCGREW, who for the past twenty-five years has been assistant engineer in the Corps of Engineers, U. S. A., Cincinnati, Wheeling and Pittsburgh districts, has been appointed district engineer for the Nashville and Chattanooga districts, with headquarters at Nashville.

C. H. KUST, who for many years was city engineer of Toronto, has resigned as city engineer of Vancouver, B. C., which position he has held for the past six years, and will remove to Toronto to undertake work for a private corporation. Mr. Rust has been engaged in municipal and sanitary engineering work for the past forty years, entering the city engineer's office of Toronto as a rodman in 1877, after which time he successively served as assistant engineer and engineer in charge of sewers. In 1892 he was appointed deputy city engineer of Toronto, and in 1898 became city engineer.

W. T. NEVINS, marine architect and ship surveyor of Chicago and San Francisco, and formerly general superintendent of the Buffalo Dry Dock Co. (American Shipbuilding Co.) has been appointed superintendent of ship construction for the Chickasaw Shipbuilding Co. at Chickasaw, the new industrial center near Mobile, Ala., where the plant is now under construction.

C. F. WOMELDORF and T. G. HASTIE have been appointed assistant engineers in the capital expenditures division of the Northwestern regional district of the United States Railroad Administration. Mr. Womeldorf, with office at Chicago, will have jurisdiction over roads in Illinois, Iowa, Missouri, Wisconsin and Michigan; Mr. Hastie, with office at Spokane, Wash., will have jurisdiction of the roads in Montana, Idaho, Washington and Oregon.

JOHN GAUB, chemist in charge of the water-filtration plant at Washington, D. C., has resigned to become health officer of Montclair, N. J., succeeding Chester H. Wells, whose resignation was noted in *Engineering News-Record* of July 25, p. 201. Mr. Gaub is a graduate of Rutgers and served for a time as instructor at Cornell and as dairy inspector at New Brunswick, N. J., his home town.

ARTHUR REIMER, formerly engineer of water supply, East Orange, N. J., who recently was released from the Corps of Engineers as a major to assist in the work of perfecting sanitary arrangements in cantonments, has been transferred to the Muscle Shoals project, where he will have charge of the erection of homes for laborers engaged on the work.

R. P. WILSON, until recently division engineer on the Hudson Bay Ry., has opened offices in Vancouver, B. C., to resume private practice, in which he had been engaged for the past fourteen years, until his work on the construction of the last 90 miles of the Hudson Bay Ry. from Kettle Rapids to Nelson.

GEO. A. HARWOOD, engineering assistant to the vice-president of operation of the New York Central R.R. at the time of the appointment of a Federal manager, has been appointed corporate chief engineer of the New York Central R.R., Michigan Central R.R., Cleveland, Cincinnati, Chicago & St. Louis Ry., Pittsburgh & Lake Erie R.R. and the other New York Central lines. Mr. Harwood's service with the New York Central dates from 1900. In 1898 he was graduated from Tufts College, and for two years thereafter he was in the employ of the Boston & Maine R.R. In 1900 he came to the New York Central as draftsman. A year later he was made special assistant to the designing engineer. In 1904 he was appointed engineer of grade crossing elimination. Early the following year he was transferred to the electric zone improvement work in and near New York City as assistant terminal engineer of the new Grand Central Terminal. Before the end of the next year (1906) he was promoted to chief engineer of the electric zone improvements. This position he held until 1916, when, with the virtual completion of the electric zone improvements, he was made engineering assistant to the vice-president of operation.

W. L. BRECKINRIDGE, engineer maintenance of way of the Chicago, Burlington & Quincy R.R., has been appointed chief engineer, succeeding A. W. Newton, who has joined the staff of the Burlington corporation.

WILLIAM H. ADAMS of the firm of Adams & Cummins, consulting engineers, Detroit, Mich., and Houston, Tex., has been commissioned as captain in the Quartermaster Corps, and is for the present stationed in Washington, assigned to duty with the Construction Division.

H. M. FREEBURN has resigned as assistant engineer of the Pennsylvania State Department of Health to become associated with the engineering staff of Wallace & Tiernan Co., Inc., manufacturers of chlorine control apparatus and sanitary engineering specialties. Mr. Freeburn became associated with the engineering branch of the Pennsylvania State Health Department while an instructor at Pennsylvania State College in experimental sewage work.

A. L. VALENTINE, for eight years and until recently superintendent of public utilities in Seattle, and for four years engineer of Kings County, Washington, has been appointed Seattle manager for the Coast Culvert & Flume Co., Portland.

M. Z. BAIR, for several years principal assistant engineer of the division of sanitary engineering, Ohio State Department of Health, has resigned for the period of the war to enter the Construction Division of the Quartermaster Corps, with the rank of captain.

J. G. RONEY and M. S. TOOPS have been appointed assistant engineers of the Texas & Pacific Ry. at Marshall and Big Springs, Texas, respectively. M. L. Ford, assistant engineer at Alexandria, La., has been appointed assistant engineer also of the Louisiana Railway & Navigation Co.

M. W. GRISBY, of the Grisby Engineering Co., East Peoria, Ill., has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps.

SAM G. PORTER, for the past five years assistant chief engineer and acting commissioner of irrigation of the Department of the Interior at Calgary, Alta., has been appointed superintendent of operation and maintenance of the Lethbridge Irrigation System, with headquarters at Lethbridge, Alta., under the direction of the Canadian Pacific Ry. Mr. Porter's work in connection with the Lethbridge project will be conducted under the direction of A. S. Dawson, chief engineer, department of natural resources, Canadian Pacific Ry., at Calgary.

S. NEWBOLD VAN TRUMP, assistant engineer of the water department of Wilmington, Del., has been appointed chief engineer of the department, succeeding Edgar M. Hoopes, Jr., resigned to enter Government service.

A. C. JESSEN, formerly assistant engineer of the International & Great Northern Ry. at Houston, Texas, has been appointed assistant engineer at San Antonio. T. S. Bond has been made assistant engineer at Palestine, Texas.

T. E. BLISS, assistant engineer of the St. Louis-San Francisco Ry. at Memphis, Tenn., has been appointed district engineer of the lines east of the Mississippi River, and the Birmingham Belt R.R., with office at Birmingham. Mr. Bliss, who was graduated from the University of Kansas in 1909, has been with the St. Louis-San Francisco since that year.

A. TAGGART ASTON, assistant port engineer of Seattle, has been appointed engineer of the recently organized port of Everett, Wash., and will immediately undertake soundings of the port and plans of improvement required by the port law.

B. B. BYERS has resigned as general superintendent of the Dravo Contracting Co. of Pittsburgh, to become associated with the Raymond Concrete Pile Co., with headquarters at Baltimore.

D. E. GELWIX, assistant engineer of the St. Louis-San Francisco Ry. at Springfield, Mo., has been appointed district engineer at the same point. H. B. Barry, district engineer at Memphis, Tenn., has been transfered to Springfield.

ALBERT J. FEENEY has been appointed assistant engineer of the water department, Wilmington, Del., succeeding S. Newbold Van Trump, appointed chief engineer of the department, as noted elsewhere.

H. M. BASSETT, formerly special assistant engineer of the New York Central R.R., has been appointed engineer of roadway and structures under the corporate organization.

LAVERNE J. RUDDOCK, city engineer of Wheaton, Ill., has been commissioned as captain in the Engineer Officers' Reserve Corps.

W. A. SPELL, assistant engineer of the Atlanta, Birmingham & Atlantic Ry., has been appointed principal assistant engineer of that line, the St. Louis-San Francisco lines east of the Mississippi River, and other lines under E. T. Lamb, Federal manager. O. T. Nelson has been appointed engineer maintenance of way. L. R. Brine has been made district engineer of the Atlanta, Birmingham & Atlantic. The offices of all are at Atlanta.

S. J. FORTIN, who has been attached to the Public Works Department of Ottawa, has been appointed deputy chief engineer of the city of Montreal, succeeding Alexander Martin, who has resigned.

THOMAS F. BOWE, consulting engineer, New York City and Rutherford, N. J., has been commissioned as captain in the maintenance and repair branch of the Quartermaster Corps, and assigned to duty at Camp Merritt, N. J.

A. H. PORTER, engineer of roadway of the Charleston & Western Carolina Ry., Augusta, Ga., has been made district engineer at the same point.

B. J. T. JEUP, chief engineer of the Indianapolis Water Co. and previously city engineer of Indianapolis, has been elected a director of the water company, succeeding Harry E. Jordan, who has entered military service.

E. M. VAIL, of Newark, N. J., has been appointed division engineer in charge of the office of the Northern division of the New Jersey State Highway Commission, which has been opened at 790 Broad St., Newark.

A. B. EDGE, division engineer of the Atlanta & West Point R.R. and the Western Ry. of Alabama at Atlanta, has been appointed district engineer at the same point.

B. M. THOMSON of the office of the city engineer, Charleston, S. C., has been appointed to the Sanitary and Drainage Commission of that city, succeeding Capt. J. W. Martin, recently commissioned in the Corps of Engineers.

J. M. SILLS, district engineer of the St. Louis-San Francisco Ry. at Springfield, Mo., has been appointed assistant chief engineer, with headquarters at St. Louis. Mr. Sills has been in the service of this railroad since his graduation from Kansas State University in 1903. He was promoted to district engineer in 1907.

WILLIAM PIGOTT, supervisor of wood ship construction for the United States Shipping Board in the Washington District, with headquarters at Seattle, has resigned to undertake other work.

A. O. POWELL, consulting engineer, Seattle, who was a retired army officer of the Corps of Engineers and who recently reëntered the service with the rank of captain, has been promoted to the rank of lieutenant-colonel. Lieut.-Col. Powell served as president of the Pacific Northwest Society of Engineers during 1912.

H. T. CORY, consulting engineer, of San Francisco, who has been in Washington on Red Cross work for some time, recently returned to San Francisco only to find there a telegram from Secretary Franklin K. Lane, recalling him to Washington immediately on arrangements for reconstruction work for soldiers and sailors returning from the battlefields.

OBITUARY

HENRY W. KLAUSMANN, city civil engineer of Indianapolis, died suddenly at his home Aug. 14. He was born at Centralia, Ill., Sept. 2, 1868, and went with his parents to Indianapolis in 1878, where he received his school education, after which he had some training in the office of an architect. From 1901 to 1910 he was county surveyor of Marion County, of which Indianapolis is the county seat. During that time several of the highway bridges across White River and Fall Creek were built. From 1910 to 1914 he was city engineer of Indianapolis and in January, 1918, was reappointed to this position. Since 1914 he had been engaged in private practice as an engineer and contractor.

AUGUSTUS MORDECAI, who had been engaged in railroad and consulting engineering work for the past forty-five years, died in Cleveland July 28, in his seventieth year. Born in Philadelphia, he graduated from the Polytechnic College of Pennsylvania, and then served for about a year as rodman in the construction of the Dutchess & Columbia R.R. During the next four years he was in charge of various railroad construction work. In 1872 Mr. Mordecai went to Cleveland as division engineer in charge of maintenance on the Atlantic & Great Western R.R., which was afterward merged into the present Erie system. For twenty years he remained in Cleveland, associated with the Erie and with its successors, successively filling the positions of division engineer, resident engineer and general roadmaster. From 1894 to 1896 he was acting chief engineer at New York. For ten years thereafter he remained in Cleveland as assistant chief engineer in charge of construction and maintenance on all the lines west of Salamanca. Later he became associated with J. H. Stevens as office engineer in the valuation of the New York, New Haven & Hartford R.R., until the completion of that work. After 1909, Mr. Mordecai was active in Cleveland as a consulting engineer, being prominently connected with the construction of the belt line around Cleveland and with valuations of various railroad properties. He was also a member of the Cleveland River and Harbor Commission. He was a member of the American Society of Civil Engineers and the American Railway Engineering Association, and a charter member of the Cleveland Engineering Society. He was a member of the board of direction of the American Society of Civil Engineers in 1895-97.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Pooling of Resources in Prospect When Sand, Gravel and Stone Industries Organize

New Government Policy Hitherto Impossible Under Sherman Law Result of Meeting with War Industries Board

By WINGROVE BATHON
Washington Representative, Engineering News-Record

The first admission for publication of the truth of rumors current in Washington, that the United States Government is endeavoring to find a way for the pooling of the resources of the industries represented, was made at a meeting in Washington last week between the War Industries Board and representatives of the various sand, gravel, crushed stone and slag associations. More than 200 producers of these materials met with the building-materials section of the War Industries Board, of which Richard L. Humphrey is chairman. Out of the meeting grew the formation of the war-service committee for these industries in one combination (although they had separate problems and have worked separately before), as well as the division of the United States into zones of production and distribution with the expectation of an agreement as to prices in these zones.

POSSIBILITY OF POOLING

Admission of a possibilty of a pooling system came from A. P. Sandles of Columbus, Ohio, secretary of the National Crushed Stone Association. "If pooling is done," Mr. Sandles said to the writer, "and I understand from the Priorities Board that it is likely that it will be, it will be under an arrangement by which some of the plants will be closed down and those closed down will share in the profits of those which are operated. Of course, in the old days before the war, such an arrangement would have been impossible under the Sherman Law, and under the Valentine Law of Ohio, as well as under other State laws, but the war alters everything." Such an agreement necessarily carries with it the fixing of prices.

While these indications of the possibility of a pooling arrangement will come as a surprise to some producers, especially in some of the other industries, who have not yet been called to Washington to confer with the Government, no surprise is expressed in well informed circles in Washington, where it has been well understood that if any such arrangement is to go through it will go through with the consent or at least with the passive knowledge of the highest legal officers of the Government. In this connection, too, the question is being asked in Washington how, if this is to be a Government policy, it will effect the industries engaged with cement, brick, terra cotta and sewer pipe.

QUESTION TO BE ANSWERED

Again, in industrial circles in Washington, these questions are being asked: On what basis will the earnings of those in the pooling arrangement be divided? Who will determine which factories shall be closed down and which shall operate? What percentage of payment will the plants shut down receive? Who will determine that percentage? As business increases or decreases who will determine what plants shall continue to operate or what plants shall continue shut down? Who will determine the differences in values as to management ability in the

(Concluded on page 384)

To Arbitrate Labor Problems in Lumber Industry

An agreement to arbitrate all labor difficulties was reached by Northwest lumbermen and Col. Bryce P. Disgue, commanding the air craft production of the United States Army. The conference was held in Portland, Ore., and representatives employing loggers and sawmill hands from Oregon, Washington, Idaho and Montana were present.

The problems discussed involved adjustment of wages and working conditions. The eight-hour day and the open shop will continue to prevail as a result of the conference.

Resolutions passed at the meeting formulated the procedure whereby the various questions that will arise may be arbitrated, as well as general regulations affecting the industry.

Prices of forest products were also a subject of the conference, and an adjustment was effected which is to continue during the period of the war and after peace is declared.

Government-Owned Equipment May Be Purchased

War-Material Contractors May Obtain Title to Machinery Furnished at Public Expense

Special equipment such as buildings, machinery or other facilities for increasing output, furnished at the expense of the United States to manufacturers with war contracts, may be purchased by such manufacturers under authorizations recently approved by the Superior Board of Review of the General Staff. Under this authorization manufacturers and the Government may reach an agreement whereby the manufacturers may take over such facilities at a fair valuation in diminution of the profit which they otherwise would make. Under the present terms of the contract the title on all such improvements or special facilities is vested in the United States. The new clauses in the contracts give the contractors an opportunity to take over these new facilities.

It is estimated that the cost of the increased manufacturing facilities created by the war demands, exclusive of the new industries serving the Navy and the Emergency Fleet Corporation, is approximately $400,000,000. This amount will have wide distribution and most of it has been or will be spent in sections outside the New England and Middle Atlantic States, which at present are declared a restricted area where further industrial expansion will be either discouraged or entirely discontinued during the war.

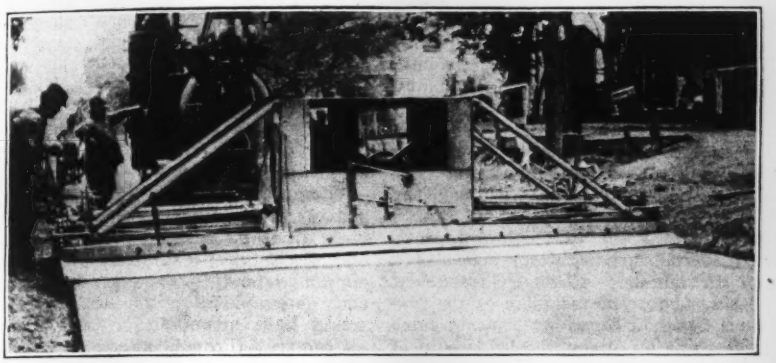
Contractors wishing to obtain title to these facilities under the new clauses of the contract may do so by making a written offer to the Government which, if agreeable to the latter, will obligate the contractor to pay for such facilities at their appraised value at the time the offer is made. They may be paid for either by lump-sum payment or by installments on an amortization plan. If the contractor is unable to make the Government an offer, or in case his offer, should he make one, is not acceptable to the Government, it retains the right to remove all facilities which have been provided at the termination of the contract and reasonable time is given to the Government to remove all facilities. The contract also provides that the Government may buy the land upon which such facilities have been erected in case it is desired to retain them, or in case a satisfactory agreement cannot be reached on the terms of purchase.

Road Finisher Produces Denser Concrete

Rapid Agitation of Aggregate Makes Possible the Use of Unusually Dry Mixture

A concrete road-finishing machine designed to eliminate voids and by means of which a coarser aggregate and dryer mix may be used is shown in the accompanying illustration.

The finishing device moves forward under its own power at a speed of about 7 ft. per minute and backs up at a speed of 28 ft. per minute. As the machine travels forward the strike-off spreads the concrete to the necessary height and proper crown. The tamper, just back



CONCRETE FINISHER PRODUCES DENSE ROAD

of the strike-off, tamps the concrete the first time over with a long, hard stroke. The second time over a short, rapid, up-and-down movement is used, which may be decreased until it is subjecting the concrete to continuous agitation without applying pressure to the mixture. The stroke of the tamper is regulated by the operator and may be varied for different consistencies of concrete as well as for different stages of progress. The float, at the rear of the machine, produces a smooth finish by sweeping a belt across the surface at a comparatively low speed.

The claims made are that by subjecting the mixture to the continuous agitation caused by the tamper, the concrete is compacted and the air in it is brought to the surface. The larger stones and only enough mortar to cement them are brought together. Because of the agitating action of the tamper, a drier mixture can be used than would be possible where the work is done by hand. The results are stronger concrete and a surface free from laitance, silt and light particles which float to the surface of a wet mixture.

The device was designed in 1913 by E. G. Carr, while a contractor in California, and has been used on the construction of about 400 miles of California highways. With the assistance of the staff of the Lakewood Engineering Co., Cleveland, Ohio, the mechanical details have been improved and the machine placed on the market.

Limited Imports of Crude Rubber and Creosote Oil Permitted

Permission to import crude rubber and creosote oil for a limited time is announced in bulletins received from the War Trade Board at Washington. This decision has been reached, it is stated after a study of the needs of the country.

The bulletin covers the permission to import 2,000,000 gal. of creosote oil from Japan during the remainder of the present calendar year, and states that licenses for this may be issued during the remainder of the year when the applications are otherwise in order, with the proviso that such oil is to be shipped on vessels approved for that purpose by the Shipping Control Committee of the United States Shipping Board. The importation of crude rubber will be limited to 16,666 tons in the months of August and September.

The importations permitted by these bulletins will be distributed by the Bureau of Imports of the War Trade Board, and in the case of rubber the general lines of previous allocations have been subjected to certain changes.

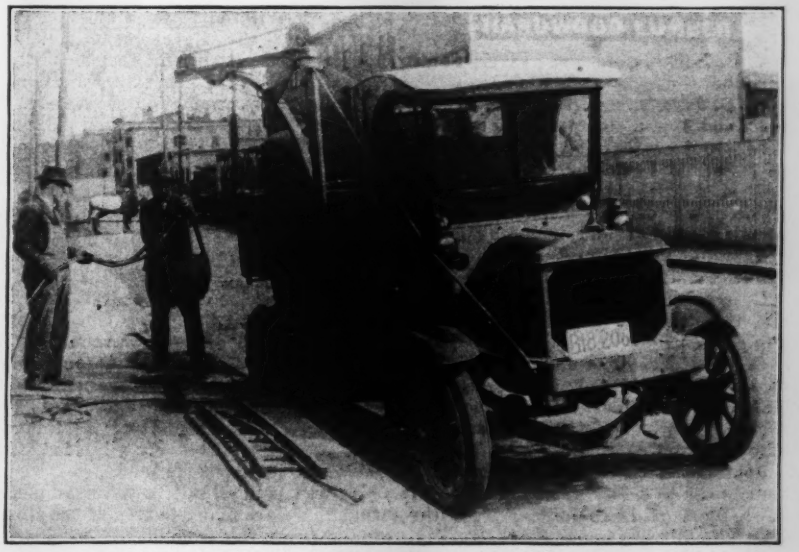
Have It Shipped Now—Suggestion for Material User

A recent circular issued by the Navy Department urges navy contractors to have all or as much as possible of their raw materials shipped at once. It points out that at the present time the transportation situation is well in hand because of the improvement of rail conditions. From now on, however, the volume of traffic will increase more rapidly than terminal and storage facilities can be provided, and this will produce congestion. A repetition of the weather conditions of last winter will bring a corresponding congestion. This will create the danger of a complete shutdown of vital industries unless the situation is forestalled by careful study of the matter in order that needs may be anticipated.

City Truck with Labor Saving Catch Basin Cleaner

A city department truck equipped with a labor-saving device for cleaning catch basins, designed by L. F. Hastings, city engineer of Cambridge, Mass., and his associate, is shown in the accompanying illustration. It was adopted as a result of the extreme labor shortage in that city.

A 3½-ton Federal truck, equipped with the steel body of 3 cu.yd. capacity and a power dumping hoist, was purchased from the Federal Truck Co. and the special machinery for excavating the material and loading it into the truck body was made in a local machine shop from drawings made in Mr. Hastings' office. The excavating is done by a bucket of the "orange-peel" type, having four jaws which are opened and closed by compressed air. The power to drive the air compressor and the hoist is obtained from the motor of the truck by a sprocket chain on the truck propeller shaft.



CLAMSHELL OPERATED BY TRUCK CLEANS CATCH BASINS

Pooling of Resources

(Concluded from page 382)

different plants, the conditions of equipment, etc.? On what basis are prices to be fixed?

These difficult questions will press for a solution before it can be definitely determined whether there shall be a pooling arrangement, under what was known, according to the Sherman Law, in the old days before the war, as "a combination in restraint of trade." The new War Service Committee of the sand, gravel, crushed stone and slag industries will meet again in Washington in September with the representatives of the War Industries Board, by which time it is likely that there will be a definite determination of the Government's policy.

Personnel of Committee

In the following table will be found the members of the new committee, with the industries they represent, and the zones of control which they represent:

B. D. Pierce, stone; New England states.

James G. Shaw, stone; metropolitan New York, comprising the territory within the free lighterage limits of New York.

George D. Van Seiver, sand and gravel; metropolitan Philadelphia, comprising the territory in New Jersey south of and including Trenton, Pennsylvania east of and including Harrisburg, and the state of Delaware.

J. H. Rogers, sand and gravel; states of New York and Pennsylvania outside of the metropolitan districts of New York and Philadelphia.

Joseph J. Rock, sand and gravel; Maryland, District of Columbia, and the state of Virginia north of but not including Fredericksburg.

W. F. Shaffner, stone; Kentucky, Tennessee, Alabama north of and including a city yet to be selected, and Mississippi north of and including a city yet to be selected.

A. P. Burke, sand and gravel; South Carolina, Georgia and Florida.

W. F. Jancke, sand and gravel; Alabama south of a city yet to be selected, Mississippi south of a city yet to be selected, and Louisiana and Texas.

P. M. Lewis, sand and gravel; Wisconsin south of and including Racine, Illinois north of and including Joliet, and Indiana north of and including Crown Point.

G. A. France, stone and slag; Ohio and the southern peninsula of Michigan.

G. V. Miller, stone and slag; Indiana south of Crown Point, Illinois south of Joliet, Missouri east of and including a city yet to be selected, and Iowa east of and including Des Moines.

John Prince, sand and stone; Missouri west of a city yet to be selected; Iowa west of Des Moines; Nebraska, Kansas and Oklahoma.

A. J. Blair, stone; Wisconsin north of Racine, the northern peninsula of Michigan, North Dakota, South Dakota and Minnesota.

C. S. Lambie, sand and gravel; Montana, Wyoming, Colorado, New Mexico and Utah.

There are fifteen names in the above list, and it is intended that the committee shall number seventeen. There were no delegates present from Washington, Oregon and Idaho, for whom a committeeman will be selected later, and the same thing applies to the states of California, Nevada, and Arizona.

There was, however, a splendid representation from the industries all over the country with the exception of the six far Western states mentioned, and the meetings were spirited. The call for a meeting was sent out by Mr. Humphrey of the War Industries Board July 31.

Notwithstanding the desire of the War Industries Board that there should be a reasonably small and active and representative body in Washington at the meetings, about 100 members of the National Sand and Gravel Association came to Washington a day in advance of the scheduled meeting with the War Industries Board, under the leadership of Harry Donnelly, of Cincinnati, president of that organization, and also a day in advance of the Government meeting about 100 members of the National Crushed Stone Association came to Washington, under the leadership of A. J. Blair of Wisconsin, president, and A. P. Sandles, secretary.

Represented as One Industry

This was done because the members of both associations desired to be grouped separately and dealt with separately by the Government as two distinct industries, notwithstanding the desire of the Government, expressed in its call, that all of the sand, gravel, crushed stone and slag industries be represented as one industry under one war-service committee. Representatives of both associations held a meeting the day before the Government meeting and adopted resolutions declaring that they desired to act separately and have their problems considered separately.

These views were outlined to the Government the following morning, when Mr. Humphrey of the War Industries Board called the gathering together. A. J. Blair was elected chairman and E. Guy Sutton, secretary of the National Sand and Gravel Association, was elected secretary. Mr. Humphrey pointed out that it was to the best interest of the Government that all the producers present should deal with the Government through one committee, and that in the end that arrangement would be to the best interest of all the producers. As the result of compromises on all sides, the one committee was formed.

It was pointed out in the arguments that there are many phases of the stone industry which should be considered entirely separated from the sand and gravel industry. A large output of many of the quarries is now used for fluxing purposes. Much of it is used for agricultural lime purposes, beet-sugar making and chemical purposes, such as in nitrate and soda-ash plants, while the sand and gravel industries are not interested in the details of these uses. Crushed stone, it was also pointed out, is used for ballast and mineral aggregates, for concrete purposes and macadam-road building. Of all the stone produced, it was stated, only 25% is used for mineral aggregates, the other 75% being used for purposes entirely different from that in which gravel is used. The delegates to the meeting also told Mr. Humphrey that his War Industries Board section would be handling the whole production of the stone industries, when only about 25% of their output ought to come under the supervision of his section and the remainder ought to come under other sections of the War Industries Board, and possibly, even probably in the case of ballast, under the control of the Director General of Railroads. The sand men supported these views.

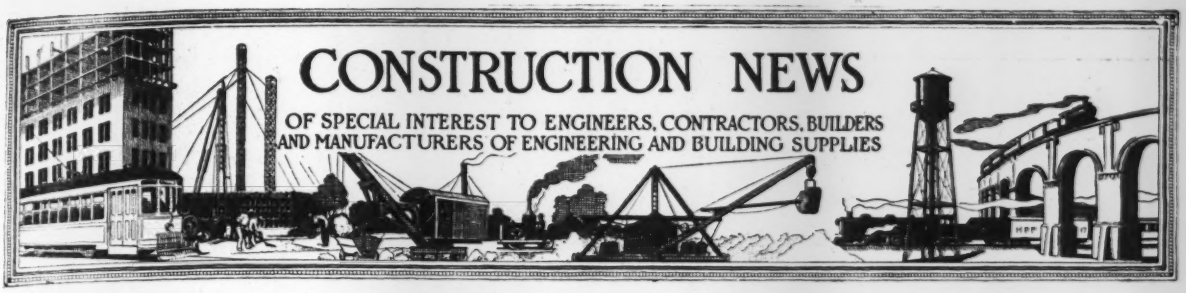
When it was found that the sand, gravel, crushed stone and slag men were all to be grouped together under one war-service committee, each association wanted to name one man for each geographical group or zone, which would have meant two committeemen all the way through, and three in districts where slag is produced. To this the War Industries Board was at first inclined to agree, providing the zone groups be reduced to five or seven. Committees from the associations, however, finally brought in a report dividing the United States into seventeen groups mentioned at the beginning of this article, and there is every expectation in Washington that the committeemen named to represent the groups will soon be charged in their respective districts, under the authority of the War Industries Board, if the Government policy works out, with the administration of the pooling arrangement proposed, the fixing of prices, the production and distribution of materials and above all with the curtailment of transportation and the saving of coal.

The sand, gravel and stone interests were represented officially by the officers of their associations already mentioned. H. J. Love, secretary, represented the National Slag Association.

Business Notes

L. R. Boyer, formerly with the Bureau of Standards, Washington, D. C., has joined the organization of E. & T. Fairbanks & Co., scale manufacturers, St. Johnsbury, Vt.

Henry Stroh, who has been connected for several years with the Elliott Frog and Switch Co., has joined the Walter A. Zelnicker Supply Co. in the sales department.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

Resume of Six Months' Building Construction

Building Contracts Reflect General Conditions

Résumé of Six Months' Work Indicates Distribution of War Work and Increased Coal Consumption

Summarizing of the building contracts from the Construction News Section of *Engineering News-Record* for the first six months of the year, and dividing of it into classes of construction as well as monthly progress, indicates the distribution of the work, especially that pertaining to the war, as well as the reasons for the coal demand exceeding all estimates made at the beginning of the year. The charts further illustrate the reasons for the Government order restricting the expansion of industries in the East and Northeast, as well as the preponderance of cantonment work in the South. The increase in construction in May and June, as shown by Fig. 1, shows that the estimates for the coal supply made out in the first of the year were adequate until the expansion started in May. From data available for July, not shown on Fig. 1, a sharp rise in Government contracts is indicated, together with a continued rise in industrials, the latter rise being the chief factor in the coal situation.

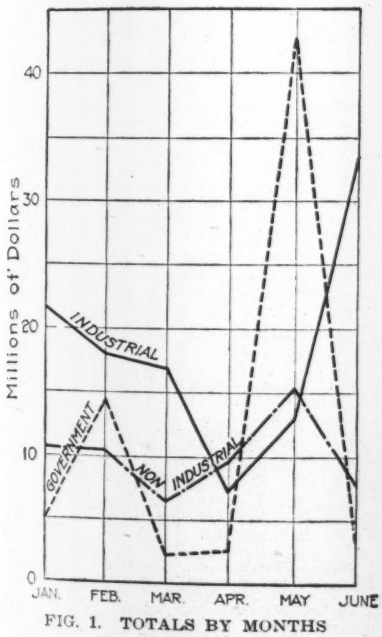


FIG. 1. TOTALS BY MONTHS

Fig. 2 indicates that the Southern states have the largest amount of construction, but two large items which appeared after the chart was made in the Middle Atlantic states, and which were omitted to permit of verification, will increase the totals for the Middle Atlantic states to $114,000,000 approximately. Comparing these figures to the total amounts, we find that the Government work is the largest, with 48% of all the work done, the industrials coming next with 34% and the non-industrial with 18%. The industrial work alone in the Middle Atlantic states comprises 40% of all the work done. Government work in the Southern states coming next, with 25.8%, followed by Government work in the Middle Atlantic states with 16.5%, the next largest being the industrial work for the Middle Atlantic states, with 13.6%. It will be observed that, with the exception of the Government work, of which 53% lies in the Southern states, the Middle Atlantic states have the largest proportion of all three classes of work, with the exception of the non-industrial.

The total amount of non-industrial work for the six months as shown on Fig. 1 is approximately $60,000,000. Normal prewar estimates would increase this amount to over twice this figure.

The decline of this non-industrial work, which includes city office buildings, churches, schools, theaters, dwellings, etc., shown in Fig. 1, coupled with the small showing for this class in Fig. 2, is the cause for the alarm and complaints of the industries dependent on this class of work. Representatives of these industries point out that although there is an indication of further Government work, the limit is not far off, even should the new man-power bill become law. In commenting further on this situation, they say that the industries dependent on building construction are subject to a larger proportion of restriction, both direct and indirect,

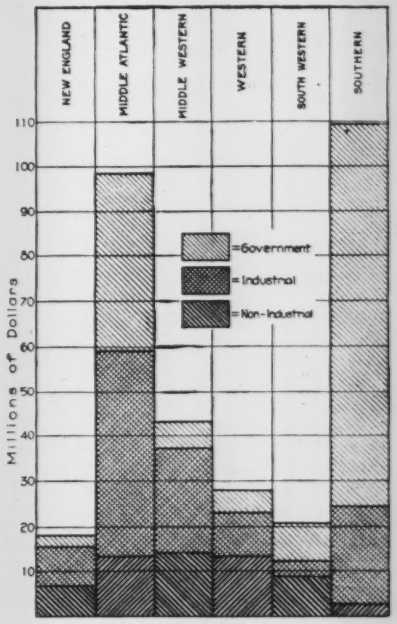


FIG. 2. DISTRIBUTION OF SIX MONTHS' CONTRACTS BY DISTRICTS

than any outside those taken over by the Government.

A recent ruling of the War Industry Board restricts coal to the cement industry, thereby cutting down production 25%. Steel distribution is so strictly regulated and the government demand so heavy, that this vital necessity is almost impossible to get, and the Capital Issues Committee restricts the financial side of the business. They say that these restrictions are becoming so acute as to threaten extinction of activities highly necessary for peace time work.

On the other hand war work is creating a large housing demand which in turn will bring municipal expansion in industrial centers with its necessary municipal improvements, such as streets, sewers and water-works. These factors are all vitally dependent on the continuation of the war, they point out, and since students of the financial and general war situation say that in all probability hostilities will end suddenly, they say it is evident that the probable collapse of this expansion will create a situation dangerous not only for themselves but for all related industries.

It is on these grounds that they base their urgent requests to the War Industries Board to take up their problems at an early date.

PROPOSALS

For Proposals Advertised See Pages 52 to 56 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Aug. 26	Pierre, S. D.	Aug. 15
Aug. 26	Belleville, Kan.	Aug. 22
Aug. 29	Ossining, N. Y.	Aug. 1
Sept. 2	Freeport, O. Adv. Aug. 8.	Aug. 8
Sept. 3	Martinez, Cal.	Aug. 22
Sept. 6	Grafton, N. D.	Aug. 15

SEWERS

Aug. 26	East Youngstown, O.	Aug. 22
Aug. 26	Newcomerstown, O.	Aug. 22
Aug. 26	Woodville, O.	Aug. 22
Aug. 26	Brooklyn, N. Y.	Aug. 22
Aug. 29	Ossining, N. Y.	Aug. 1

BRIDGES

Aug. 26	St. Clairsville, O.	Aug. 15
Aug. 26	Hanover, Va.	Aug. 22
Aug. 26	Zanesville, O.	Aug. 22
Aug. 27	Franklin, W. Va.	Aug. 1
Aug. 28	San Diego, Cal.	Aug. 15
Aug. 30	Merion Sta., Pa.	Aug. 15
Aug. 30	Columbus, O.	Aug. 22
Sept. 4	Mt. Holly, N. J. Adv. Aug. 2.	Aug. 22
Sept. 10	Rockford, Ill.	Aug. 15
Sept. 16	Great Falls, Mont. Adv. Aug. 22.	Aug. 22

STREETS AND ROADS

Aug. 24	West Allis, Wis.	Aug. 15
Aug. 26	Geneva, Ala.	Aug. 1
Aug. 26	Boston, Mass.	Aug. 22
Aug. 26	St. Peter, Minn.	Aug. 22
Aug. 26	Bethany, Mo.	Aug. 22
Aug. 27	Chaska, Minn.	Aug. 8
Aug. 27	Columbus, O.	Aug. 15
Aug. 27	Ripley, W. Va.	Aug. 22
Aug. 27	Jersey City, N. J.	Aug. 15
Aug. 27	Winfield, W. Va.	Aug. 22
Aug. 27	Boston, Mass.	Aug. 22
Aug. 27	Mantorville, Minn.	Aug. 22
Aug. 27	Walker, Minn.	Aug. 22
Aug. 27	Dormont, Pa.	Aug. 22
Aug. 27	St. George, N. Y.	Aug. 22
Aug. 28	Mt. Holly, N. J.	Aug. 15
Aug. 28	Willmar, Minn.	Aug. 8
Aug. 28	Boston, Mass.	Aug. 22
Aug. 28	Aitkin, Minn.	Aug. 22
Aug. 29	Colorado	Aug. 15
Aug. 29	Yorktown, O.	Aug. 8
Aug. 29	Newark, N. J.	Aug. 22
Aug. 30	Michigan	Aug. 8
Aug. 30	Pennsylvania Adv. Aug. 15 and 22.	Aug. 15
Aug. 30	Ohio	Aug. 22
Aug. 31	New Mexico Adv. July 18	July 18
Sept. 1	Rocky River, O.	Aug. 15
Sept. 2	Tennessee	Aug. 15
Sept. 3	Daytona Beach, Fla.	Aug. 22
Sept. 4	New Brunswick, N. J. Adv. Aug. 22.	Aug. 22
Sept. 4	New Jersey	Aug. 22
Sept. 5	Pennsylvania Adv. Aug. 22.	Aug. 22
Sept. 5	Jefferson City, Mo.	Aug. 22
Sept. 5	Kansas City, Man.	Aug. 22
Sept. 6	Brookhaven, Miss.	Aug. 22
Sept. 6	Woodsfield, O.	Aug. 15
Sept. 9	Flemington, N. J.	Aug. 22
Sept. 13	Okanogan, Wash.	Aug. 22
Sept. 14	Bisbee, Ariz.	Aug. 8
Sept. 16	New Mexico.	Aug. 8

EXCAVATION AND DREDGING

Aug. 24	Wilmington, N. C.	Aug. 15
Aug. 25	Elizabethtown, N. C.	Aug. 8
Aug. 26	Mason City, Ia.	Aug. 22
Aug. 30	Albany, N. Y. Adv. Aug. 22.	Aug. 22
Sept. 2	Sac City, Ia.	Aug. 22
Sept. 3	Tekama, Neb.	Aug. 22
Sept. 3	Clinton, Ia. Adv. Aug. 22.	Aug. 22
Sept. 5	Whitehall, Mont.	Aug. 15
Sept. 12	Lovell, Wyo. Adv. Aug. 22.	Aug. 22
Sept. 17	Albany, N. Y. Adv. Aug. 22.	Aug. 22

NDUSTRIAL WORKS

Aug. 29	Wingdale, N. Y. Adv. Aug. 22.	Aug. 22
Sept. 1	Buffalo, N. Y.	Aug. 22
Sept. 5	Raleigh, N. C.	Aug. 15

BUILDINGS

Aug. 26	St. Peter, Minn.	Aug. 22
Aug. 27	San Francisco, Cal.	Aug. 22
Aug. 29	Ossining, N. Y.	Aug. 1
Aug. 29	Little Rock, Ark.	Aug. 15
Sept. 1	Filley, Neb.	Aug. 22
Sept. 2	Independence, Mo.	Aug. 22
Sept. 3	Middleton, Ky.	Aug. 8
Sept. 12	Bonner Springs, Kan.	Aug. 22
Sept. 15	Ardmore, Okla.	Aug. 15

FEDERAL GOVERNMENT WORK

Aug. 26	Bulkhead — Spec. 3280 — Pensacola, Fla.	Aug. 15
Aug. 26	Changes and Addition to Sewerage Disposal Plant — —Spec. 3305—Great Lakes, Ill.	Aug. 15
Aug. 26	Addition to Dispensary — Spec. 3287—Boston, Mass.	Aug. 15
Aug. 26	Extension to Prisoners' Camps—Spec. 3276—Portsmouth, N. H.	Aug. 15
Aug. 26	Roads and Walks—Spec. 3120—New London, Conn.	
Aug. 26	Camp Addition—Spec. 3304 —Great Lakes, Ill.	Aug. 22
Aug. 26	Storehouse—Spec. 3233 — Newport, R. I.	Aug. 22
Aug. 26	Refrigerating Plant—Key West, Fla.	Aug. 22
Aug. 26	Steam Mains—Spec. 3293— New York, N. Y.	Aug. 22
Aug. 26	Regimental Unit — Spec. 3303—Great Lakes, Ill.	Aug. 22
Aug. 26	Fire Apparatus and Garage —Spec. 3316—Newport, R. I.	Aug. 22
Aug. 26	Fresh Water and Distributing Systems—Spec. 3150— Ft. Mifflin, Pa.	Aug. 22
Aug. 26	Observatory Ward — Spec. 3223—Great Lakes, Ill.	Aug. 22
Aug. 26	Grading — Spec. 3278 — Indian Head, Md.	Aug. 22
Aug. 26	Extension to Boiler Plant— Spec. 3244—Washington, D. C.	Aug. 22
Aug. 26	Hospital — Spec. 3257 — Charleston, S. C.	Aug. 22
Aug. 26	Naval Training Camp — Spec. 3249—Newport, R. I.	Aug. 22
Aug. 26	Dredging — Spec. 3278 — Indian Head, Md.	Aug. 22
Aug. 26	Camp—Spec. 3249 — Newport, R. I.	Aug. 22
Aug. 26	Boilers and Superheaters— Spec. 3205 — Philadelphia, Pa.	Aug. 22
Aug. 26	Boilers and Superheaters— Spec. 3205—Norfolk, Va.	Aug. 22
Aug. 27	Brackets — Philadelphia, Pa.	Aug. 22
Aug. 27	Dwellings—Cincinnati, O.	Aug. 15
Aug. 29	Heating System—Spec. 3314 —Quantico, Va.	Aug. 22
Aug. 29	Changing Building D — Spec. 3277 — Brooklyn, N. Y.	Aug. 22
Sept. 3	Addition to Naval Air Station—Spec. 3319—Chatham, Mass.	Aug. 22
Sept. 3	Emergency Hospital—Spec. 3334—Philadelphia, Pa.	Aug. 22
Sept. 3	Foundation and Pipe Line Conduit — Spec. 3325 — Washington, D. C.	Aug. 22
Sept. 3	Heating System—Spec. 3324 —Pensacola, Fla.	Aug. 22
Sept. 3	Heating System—Spec. 3324 —Philadelphia, Pa.	Aug. 22
Sept. 3	Extension to Naval Prisoners Camp — Spec. 3275 — Paris Island, S. C.	Aug. 22
Sept. 3	Canals—El Paso, Tex.	Aug. 8
Sept. 3	Dam—Butler, Mo.	Aug. 22
Sept. 9	Fuel Oil Storage Plant — Spec. 3269—Yorktown, Va.	Aug. 15
Sept. 9	Mechanical Stokers—Pittsburg, Pa.	Aug. 22
Sept. 16	Marine Railroad, etc—Spec. 3296—Pearl Harbor, H. T.	Aug. 15
Sept. 18	Jetty Repairs — Galveston, Tex. Adv. Aug. 22.	Aug. 22
Oct. 1	Canals—El Paso, Tex.	Aug. 15

MISCELLANEOUS

Aug. 30	Transformers, etc. — Jacksonville, Fla.	Aug. 22
Sept. 3	Duct Line—New York, N. Y.	Aug. 15
Sept. 14	Cement—Bisbee, Ariz.	Aug. 8
Oct. 16	Wharf — Santo Domingo, D. R. Adv. Aug. 22.	Aug. 22

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Water-Works

PROPOSED WORK

S. C., Columbia—City plans to build additional coagulating basin to handle 12,000,000 gal. water daily. T. K. Legare, city engr.

La., Arcadia—City plans to build waterworks system. About $50,000. X. A. Kramer, Magnolia, Miss., engrs.

La., Monroe—City plans to build filtration system. About $50,000. R. O. Morrison, city engr.

O., Akron—City voted $2,000,000 bonds to improve water-works system. Noted July 25.

Ind., Clinton—City plans to improve water-works systems. About $10,000. W. Hays, supt.

Kan., Scammon—City plans to improve water-works. About $7000.

S. D., Garretson—City plans election Sept. 5, to vote on $10,000 bond issue to improve water-works. C. O. Berdahl, city aud.

Tex., Blythe—City plans election to vote on $35,000 bond issue to build water-works system.

Tex., Eastland—City plans to install water works system. J. M. Weaver, chn.

Tex., Electra—City voted $25,000 bonds to improve water-works system.

Okla., Duncan—City election Sept. 2, to vote on $50,000 bonds to extend water-works system. Benham Engr. Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Guthrie—City plans election soon to vote on $165,000 bond issue for water-works improvements. Benham Engr. Co., 1300 Colcord Bldg., Oklahoma, engrs.

Okla., Hominy—City plans to vote on $50,000 bond issue to improve water-works.

Idaho, Dubois—City soon receives bids building water-works system. Plans include excavating trenches, building tank, etc. Cotton & Wilson, Idaho Falls, engrs.